

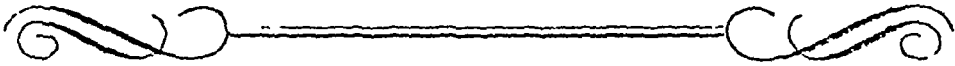
The
Modern Encyclopaedia
for Children

The
Modern Encyclopaedia
for Children

A COMPANION TO SCHOOL WORK
AND OUT-OF-SCHOOL INTERESTS FOR ALL
YOUNG PEOPLE WHO WISH
TO KNOW MORE



Odhams Press Limited
Long Acre, London



HOW TO USE THIS BOOK

An encyclopaedia is like a well-filled cupboard. Every page is a shelf stocked with information arranged for your convenience. Go to it for what you need.

If there's a subject you wish to know about—DARTS or DECIMALS, RADAR or RABBITS, CHOPIN or SHAW, KNOTS or KNITTING—the chances are that you will find it at once. And if, for instance, you look up AMERICA and don't find it, show some enterprise and look up UNITED STATES OF AMERICA.

And here's something else. Knowledge is many-sided and one thing leads to another. Quite often, then, when the book is telling you about the subject you've looked up, you will find a word printed in CAPITALS. Look up that word, too. For instance, under ECHO, you will read that an echo occurs

when SOUND waves strike a hard surface and are reflected backwards (just as a ball bounces back from a wall) to produce in the ear a weak repetition of the sound. Printing SOUND in capitals is our way of telling you that you will get more information under SOUND and that it will help to make the matter clearer.

By using the words printed in capitals as signposts directing you to other parts of the book, you can carry out many a worthwhile exploration.

To make this book, we have had to think about thousands of items, and have tried very hard to include the subjects which you are most likely to want—those you hear about at school and come across in your everyday life. As a companion to school work you will find it of great use. But don't think of it just as a school book. It is much more than that. It's your own book of facts—your reference book.

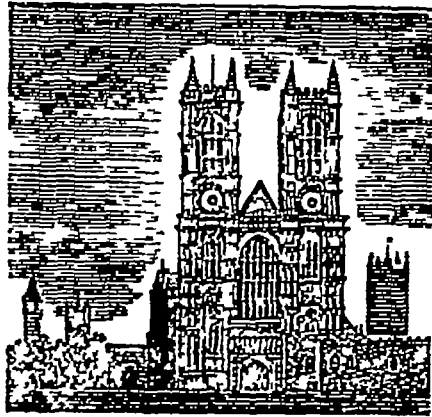
A

ARMADILLO or African ant-eater, a burrowing MAMMAL with shaggy hair, huge ears, and strong tusks. It feeds by night, breaking open cement-hard nests of white ants and licking up the ants with its long tongue. See also ANTEATER.

ABBAY is the name given to the larger monasteries, and sometimes the churches that were once attached to monasteries, e.g. Westminster Abbey. There lived the MONKS, governed by an abbot, or the NUNS, governed by an abbess. See MONASTERY, CONVENT.

ABRAHAM lived about 2,000 B.C. in the Sumerian town of Ur, which has recently been excavated. He left his home and ventured out across the desert, in the faith that God intended him to be the father of a great nation, which would dwell in a beautiful country and be a blessing to all the world.

ABSORPTION and **ADSORPTION**. A sponge or brick absorbs considerable weight of water, which penetrates in between the pores of the sponge or brick and is held there by CAPILLARY ACTION.



Westminster Abbey

Adsorption takes place on surfaces, and is the result of some attraction between the adsorbing surfaces and the substance adsorbed, such as a gas.

ABYSSINIA is a Christian native African kingdom consisting mainly of rugged highlands and deep valleys, and containing the source of the Blue NILE. Sheep and goats are reared in the more temperate highlands, and tropical crops can be grown in the lower valleys. Coffee, hides and skins are exported.



Street scene in an Abyssinian town

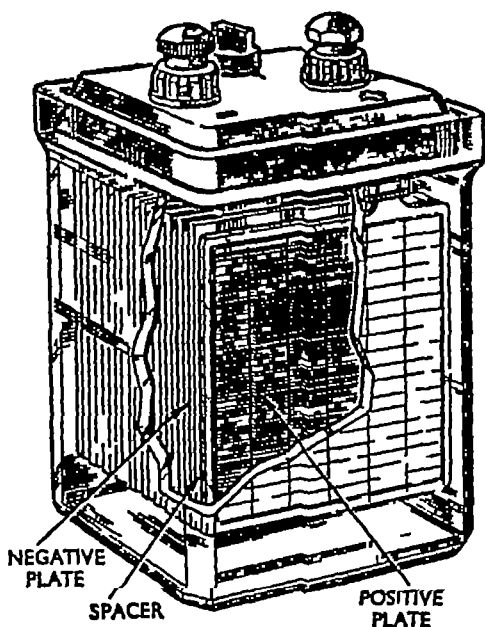
Like Sir Roger, the country squire, and Captain the soldier, reflected the thought of the times.

ADDITION is the putting of two or quantities together to find the sum or total. Remember that you can add together only things of the same kind.

through Jibuti in French SOMALI-
LAND The capital, Addis Ababa,
lies in the mountains at the head of
the only railway See map of AFRICA

ACCORDION See REED INSTRU-
MENTS

ACCUMULATOR, a BATTERY in
which the plates are not destroyed
when it generates current; they



Inside an accumulator

merely change their chemical com-
position If a "charging" current is
passed in the reverse direc-
tion, the hydrogen and
oxygen generated by the
ELECTROLYSIS convert the
plates back to their origi-
nal condition In the ordi-
nary accumulator the plate
material is lead or one of
its oxides

ana u
school is a
ID found
just a sewhere,
book ood pre-
ie manu-
silk and
ny

ACETONE is an organic liquid
used as a SOLVENT in varnishes
formerly obtained by the destruc-
tive DISTILLATION of wood.

ACETYLENE is a poisonous
strong-smelling gas which is usu-
ally prepared by the action of water
on calcium carbide It is used for lig-
hting and the OXY-ACETYLENE FLAME

ACHILLES is the chief hero of
Homer's *Iliad* and the bravest of
all the Greeks In CLASSICAL MYTHO-
LOGY his mother was the NYMPH
Thetis, who wishing to make him
immortal dipped him in the River
STYX In doing so she held him by
the heel which became his only
vulnerable part In the war against
Troy, he killed HECTOR and was
himself killed by PARIS who shot
him in the heel with an arrow

ACIDS are a group of chemical
substances which have a sour taste
turn LITMUS red and are often cor-
rosive. They can be neutralized by
ALKALIS They always contain
hydrogen, which can often be
expelled and replaced by metals
when this happens they form SALTS

ACOUSTICS is the science which
deals with the production, trans-
mission and reception of SOUND.

ACTING, the impersonation of
other people by saying what they



Imagine you are the person you are acting



In Addison's day, politicians, writers, and men-about-town met in the coffee-houses for brisk talk, argument and the latest news

would say and doing what they would do, to entertain an audience. Plays are stories written for acting. School dramatic societies give boys and girls a chance to act, the best actors being those who can feel themselves to be the characters they are imitating. This needs the active use of imagination and sympathy. See **DRAMA** and **THEATRE**.

ADDER See **SNAKE**

ADDISON, Joseph (1672-1719), was a scholar, a travelled man, a Whig politician and a friend of all the leading political, social and literary figures of his time, especially his old school friend and collaborator, Richard Steele. Like most men of culture he frequented clubs and coffee-houses, where he was in contact with leaders of thought and taste, for he lived in a time when public opinion was formed and expressed at these places. From

1709 to 1711 he contributed to the *Tatler*, a periodical started by Steele, appearing three times a week and containing a number of short essays on topics of the time, directed at the improvement of society by ridiculing in a somewhat gentlemanly way its follies and weaknesses.

It was succeeded by the *Spectator*, a daily journal on similar lines, until 1712. Addison revived this production in 1714. Steele contributed but Addison's was the moving genius. He created the imaginary "Spectator Club," the members of which, like Sir Roger de Coverley, the country squire, and Captain Sentry, the soldier, reflected the life and thought of the times.

ADDITION is the putting of numbers or quantities together to make one sum or total. Remember that we can add together only things

of the same sort eggs to eggs, houses to houses, but not houses to eggs, or books to kittens

Place the numbers so that units are under units, tens under tens, hundreds under hundreds, and so on. Begin at the top of the right-hand column, and add downwards 7, 15, 22, 29, 35. Set down 5, and carry the three tens to the next (tens) column, it is useful to put a small three over the tens column. And so proceed column by column. As a check, start at the bottom and add upwards.

If the numbers include DECIMAL points, write them with one decimal point under another, this ensures that the numbers are in the correct places. If there is no decimal point, as in 76, we can, if we like, put a decimal point and an 0 after the units figure, and write it 76 0, this shows how to place the number in the column.

ADEN is a British colony and protectorate, a desolate strip along the Gulf of Aden at the entrance to the Red Sea. The town of Aden is a coaling station on the Far East route through the Suez Canal. See map of the NEAR EAST.

ADJECTIVE. See GRAMMAR.

ADONIS is a beautiful Greek youth of CLASSICAL MYTHOLOGY beloved by VENUS. Whilst out hunting he was killed by a wild boar. Venus shed many tears, which, as they dropped to the ground, were changed into anemones, and her grief was so great that PLUTO allowed Adonis to spend six months each year on earth with Venus. In HADES he lived with PROSERPINE.

ADSORPTION. See ABSORPTION.

ADVERB. See GRAMMAR.

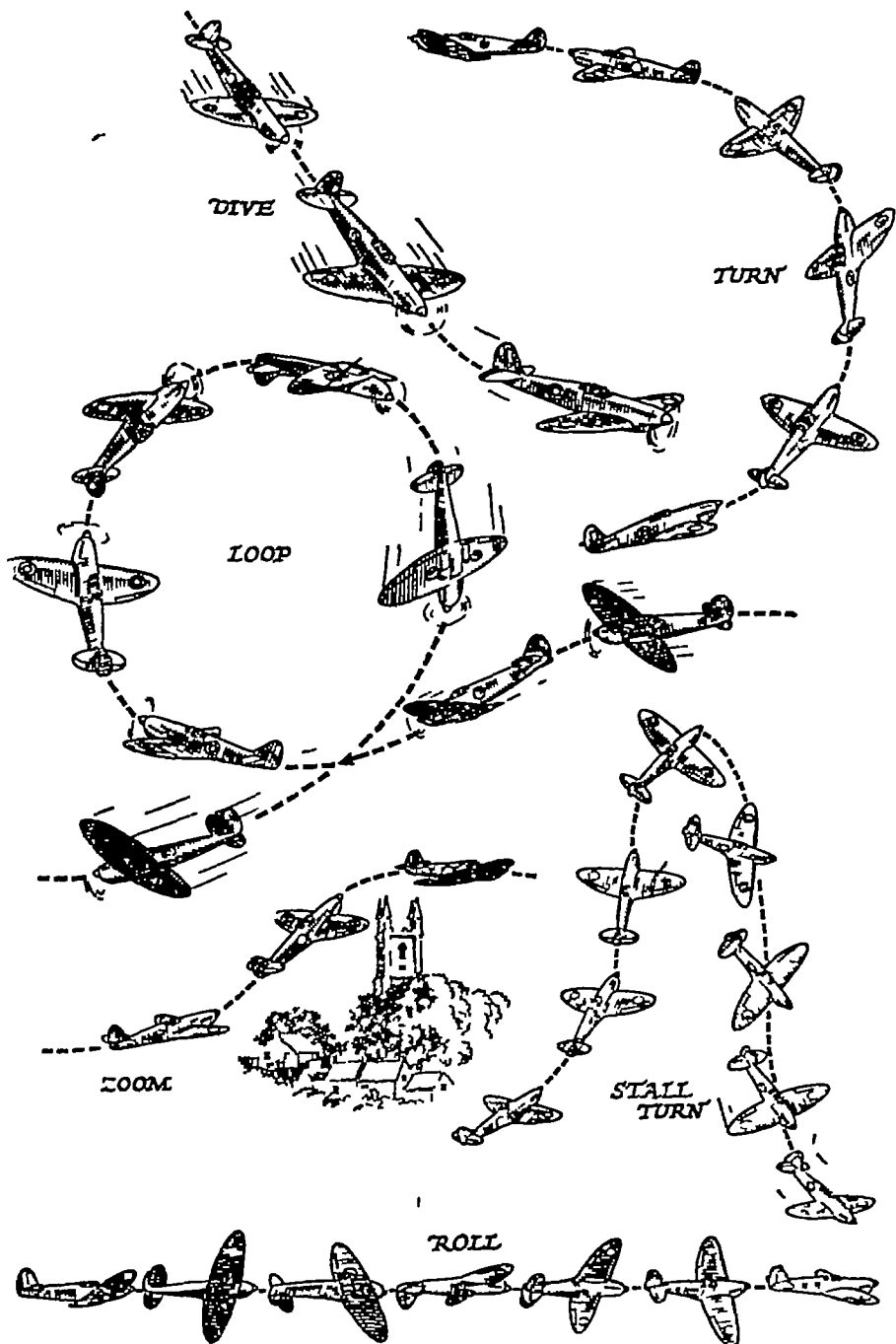
AENEAS is one of the great Trojan heroes of CLASSICAL MYTHOLOGY. When Troy was set on fire, he fled from the city and set out on those wanderings which were to form the subject of Virgil's *Aeneid*.

AERIAL, that portion of a wireless apparatus, which receives energy from, or radiates energy to, the surrounding space. It is either a high insulated wire or a coil. The latter will receive stronger signals from certain directions than from others. An aerial is sometimes called an antenna. See WIRELESS.

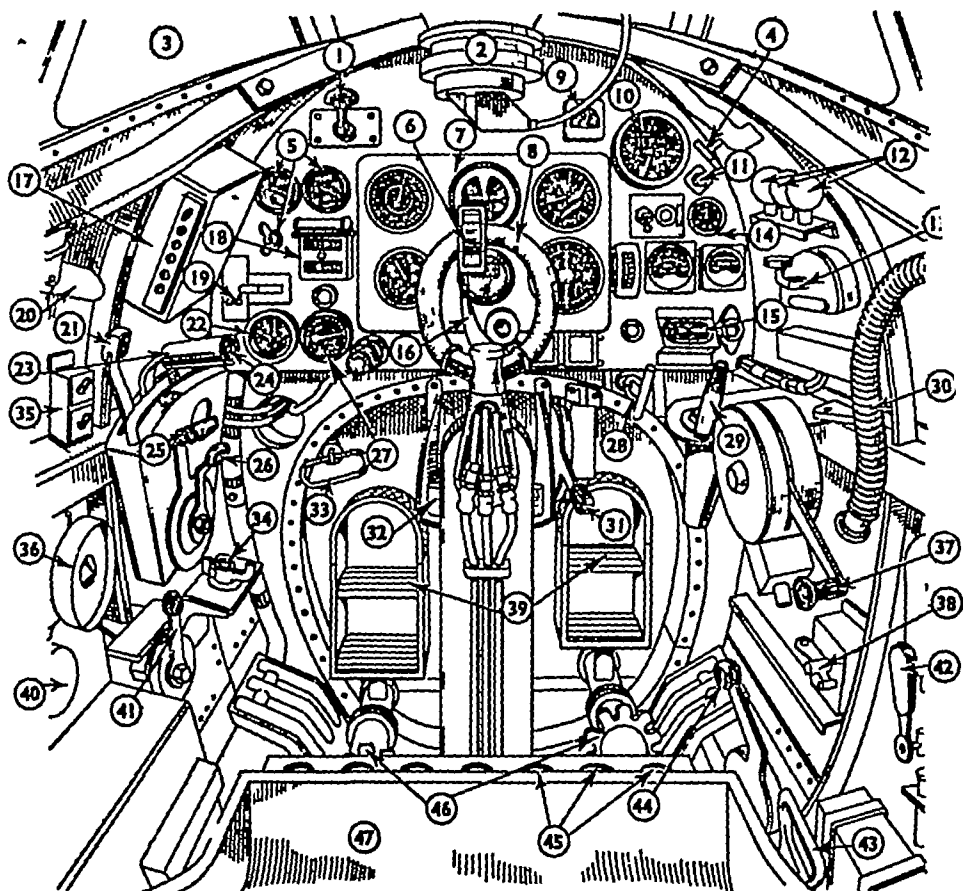
AEROBATICS is the flying of an aircraft in an abnormal or spectacular manner. Combat pilots make use of aerobatic training in fighting. There are many varieties of aerobatic manoeuvre, but the following are amongst the most common: diving, steep and stall turns, looping, rolling, half-loop and roll, zooming.

AERODROME, a ground or water area laid out for the landing, servicing and taking-off of aircraft, it is usually provided with a control tower to direct the movements of planes, hangars for housing planes, workshops for repairs, facilities for first aid and fire-fighting. It has several long runways along which planes take off and land against the wind, and a windsock showing the direction in which the wind is blowing, a movable runway indicator notifies pilots along which runway and in which direction they are to land. See picture on p 11.

AEROPLANE, a heavier-than-air flying machine, the chief parts of which are (1) the wings or planes, which are driven or pulled through the air by an airscrew or propeller, (2) the fuselage, or body, (3) the control surfaces—rudders, elevators and ailerons, (4) the propeller and motor, or other means of driving the plane through the air.



Above are the most useful manoeuvres in aerobatics. They are practised by pilots who fly fighter planes. A sudden twist or turn of his aeroplane may give a pilot a superior position for attacking his enemy or allow him to escape from a situation likely to prove disastrous.



The pilot of this fighter-bomber needs to have all his controls readily accessible and his instruments where he can see them without effort. The entry on p 14 tells you the purpose of the gadgets, and the picture above shows the main features of the pilot's cockpit. They are (1) flap control, (2) reflector gun-sight, (3) bullet-proof windscreen, (4) cockpit ventilator control, (5) oxygen control, (6) gun-firing button, (7) blind-flying instrument panel, (8) pilot's control column, (9) ammeter, (10) engine speed indicator, (11) vacuum system test connexions, (12) spare bulbs for gun-sight, (13) signalling key, (14) group of engine gauges, (15) fuel contents gauge, (16) wheel brakes control, (17) radio control box, (18) undercarriage indicator, (19) engine master switch, (20) instrument panel lamp, (21) fuel cut-off control, (22) brake pressure control, (23) throttle control handle, (24) bomb-dropping switch button, (25) propeller switch control, (26) friction adjuster, (27) elevator tab position indicator, (28) slow-running cut-out, (29) engine-priming pump, (30) oxygen supply pipe, (31) fuel cock control, (32) compass, (33) emergency bomb release, (34) fuel transfer cock, (35) bomb-fusing switches, (36) rudder bias trimming tab control, (37) undercarriage control, (38) windscreen de-icing cock, (39) rudder pedals, (40) elevator trimming tab control, (41) air-intake control, (42) emergency undercarriage-lowering control, (43) jettison tank-dropping control, (44) jettison fuel-tank cock control, (45) signal pistol cartridge stowage, (46) leg length adjustment wheels, (47) pilot's seat with box for parachute on which he sits.

See also ENGINE and JET ENGINE

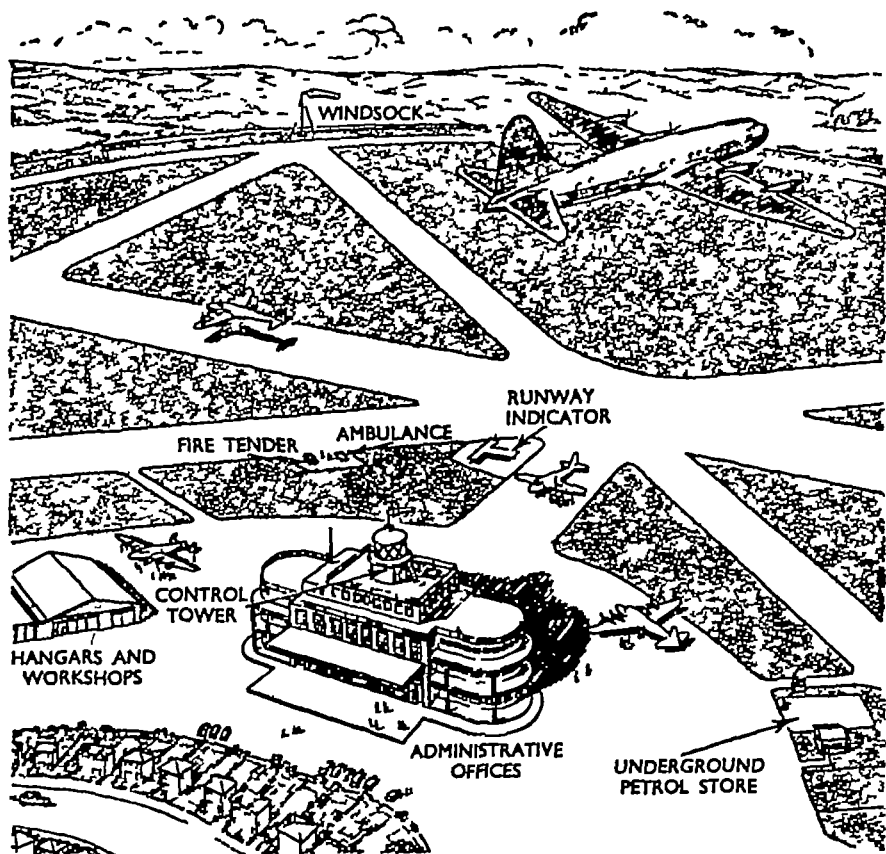
It is the wings moving forward against the resisting air which lifts the craft. The larger and longer the planes, the bigger the load that can be lifted. The curve or camber of the wing (illustration on p 12) shows the way in which the moving air passes over the wing section. The high pressure air below the wing and the low pressure air above it, caused when the wing strikes the air, force the wing upwards, and so lift the fuselage attached to the wings.

A monoplane has a single wing on each side. Biplanes have another wing above, which makes for a

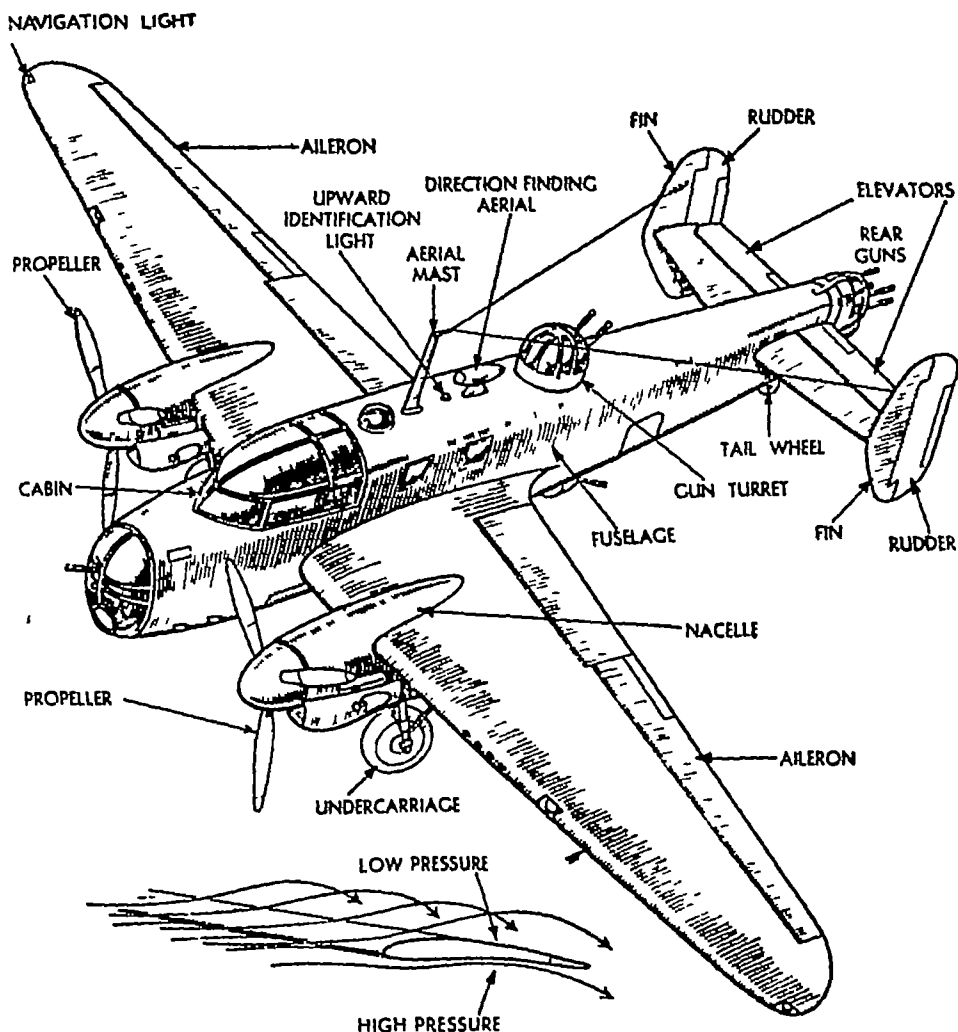
steadier and stronger plane but gives greater head resistance to wind, they are not much used today.

The *fuselage*, or cargo and passenger space, is designed to suit the type and size of the plane. On the ground it is held up by an undercarriage, with wheels on which the plane can run or taxi along the ground, the undercarriage generally folds up when the plane is in flight.

The control surfaces of first importance are the *ailerons*, the *elevators* and the *rudder*. The *ailerons* are a hinged portion of the trailing edge (the rear edge) of the main planes. By lowering the aileron on one wing, the lift on that wing is



Bird's-eye view of an aerodrome, showing the general lay-out See p 8



Parts of an aeroplane—note how the wing presses on the air

increased and the plane tilts in the other direction, by raising it the lift is reduced. The movement of the ailerons is controlled by sideways movement of the joy-stick or control column. A similar hinged horizontal surface in the tails—the elevator—causes the tail to rise or fall, and therefore makes the craft dive or climb. This surface is controlled by backwards and forwards movements of the joy-stick. The vertical rudder in the tail is controlled by the rudder bar operated by the pilot's feet, or by turning the wheel in the steering-wheel

type of control column. The action of the rudder is to turn the direction of flight horizontally. The aeroplane must be stable, that is, if a gust of wind tilts it when it is flying level on an even keel it should automatically recover. This is possible by having the wings tilted upwards as they go outwards and the tail set at a smaller angle to the fuselage than the main plane. See AERODROME, AIRCRAFT INSTRUMENTS, FLIGHT (PIONEERS OF), WRIGHT.

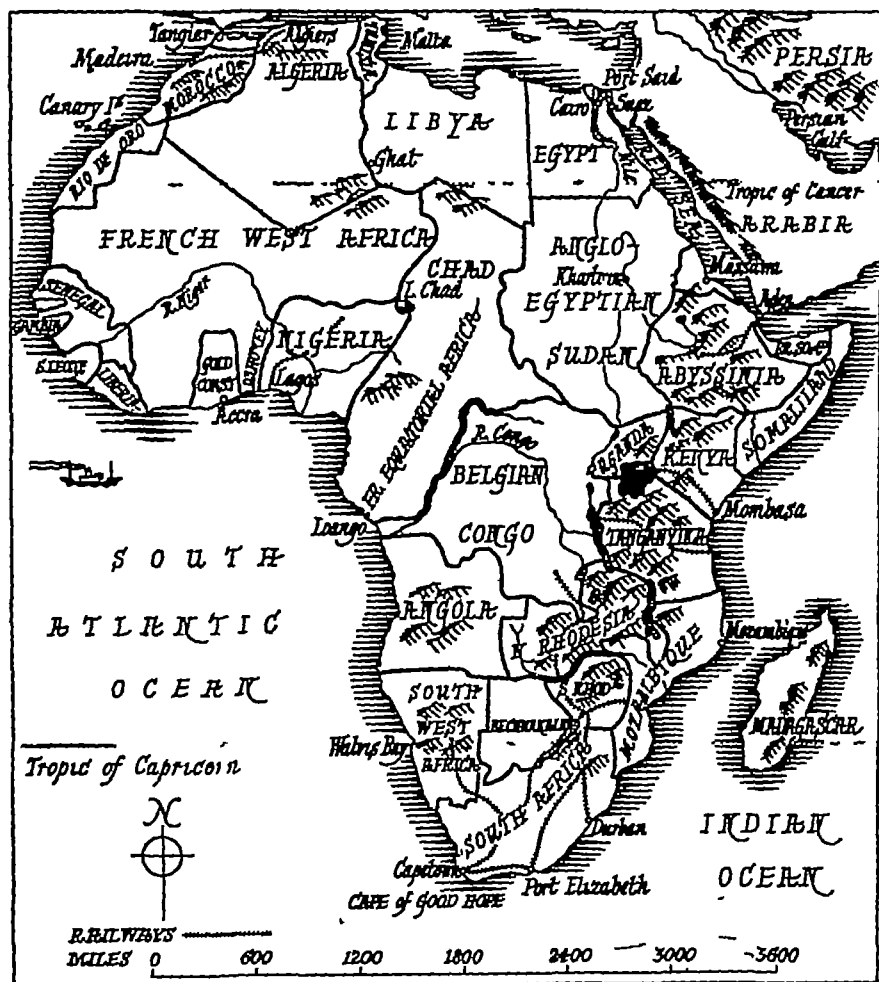
AESCHYLUS' (525-456 B.C.) fought at the battles of Marathon and Salamis before becoming the

the narrow plains along the Kabul River, where wheat, barley, almonds, figs, grapes and pomegranates are grown, elsewhere the people are PASTORALISTS. Wool, sheepskins and dried fruits are exported. The Khyber Pass is the main land route to India. See map of INDIA.

AESOP (about 570 B.C.) was a freed slave living at the court of Croesus, King of Lydia. He wrote or collected the Fables associated with his name, including *The Fox and the Grapes* and *The Wolf and the Lamb*.

AFGHANISTAN is a mountainous kingdom north-west of Pakistan. The most populated areas are

AFRICA is a continent consisting chiefly of a plateau rising towards the south and east, with great rift VALLEYS and lakes in the eastern mountains. It is drained (except in the north-west, which is covered



Map of Africa, showing the countries and the chief mountain ranges

by the Sahara Desert) by huge rivers, the largest of which are the NILE and the Congo, but rapids and waterfalls towards the coastal plains often hinder navigation. Great deserts (Sahara and Libyan) stretch across the north, and the smaller Kalahari Desert is in the south. Climate varies from sub-tropical in the south and the eastern highlands and northern coastal strip to intensely hot and damp in the dense equatorial forests. Most of the continent is sparsely settled by black people, but it has been colonized by several European nations; most white people live in the extreme south and north. See EAST AFRICA, EGYPT, MADAGASCAR, NORTH AFRICA, SOUTH AFRICA, WEST AFRICA.

AGATE is a hard stone, largely silica, used for knife-edged pivots, especially in balances for very accurate weighing.

AGNOSTIC, one who is in doubt as to whether or not God exists and who maintains an open mind on the subject.

AIDAN, Bishop of Lindisfarne, was a monk of Iona who was sent to spread Christianity in the kingdom of Northumbria at the request of King Oswald. He settled at Lindisfarne, founded many churches and monasteries, and was a bishop for sixteen years, dying in A.D. 651.

AIR is the mixture of gases, consisting largely of oxygen and nitrogen, which constitute the earth's **ATMOSPHERE**. Movements of the air result in **WINDS**. Air can be liquefied. See **LIQUID AIR**.

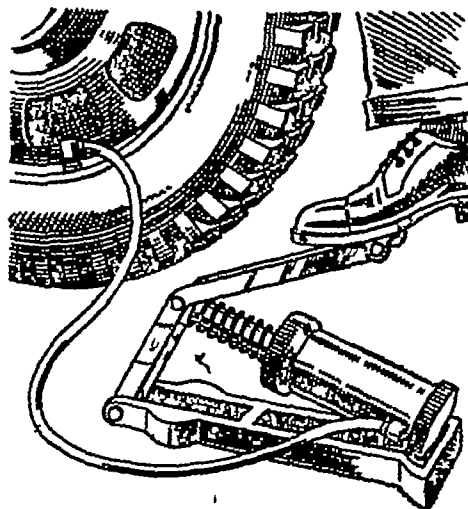
AIRCRAFT INSTRUMENTS AND CONTROLS. The instruments in the cockpit of an **AEROPLANE** fall into two classes: (1) those giving information about the plane itself, e.g. the engines, oil, lights, position of undercarriage, (2) those relating to flying and navigating the

plane, e.g. the compass, indicators for use when flying blind, the radio. The principal instruments and controls are shown in the illustration on p. 10.

AIR GUN, a weapon which throws a bullet or dart by the sudden application of high-pressure air. The air is usually compressed by a powerful spring, which has in turn been compressed by a lever action and held so until released by the trigger. It then drives forward a piston in a cylinder, thereby compressing rapidly the air in the cylinder. The latter forces the bullet or dart out along a barrel at high speed. A powerful air gun has a range of a hundred and twenty or more yards and can kill a small animal at that range.

AIR POCKET, any region up in the air where, owing to a change in vertical air currents such as occurs in hilly country, a plane seems suddenly to lose the support of the air and may drop vertically for a short distance.

AIR PUMP, a pump which moves or compresses air, but the name is used for any gas pump, or one which exhausts air and water vapour from a steam **CONDENSER**. A



A common type of air pump

simple type is shown in the illustration as the piston is forced backwards and forwards, the air is drawn in through one set of valves, compressed and expelled through another See also VACUUM PUMP

AJAX In CLASSICAL MYTHOLOGY there are two Greek heroes of this name, the Great and the Lesser, who fought at the siege of Troy

ALASKA is U S territory, to the north-west of Canada, bought from Russia in 1867 It has a population of only 90,000 although its area is about one-fifth that of the United States The climate is extremely cold except in the south, where fruit and vegetables can be grown and cattle reared Gold is mined, but salmon fishing and canning occupy most of the people American Indians and Eskimos rear reindeer introduced from Siberia The Alaska Highway connects Alaska with the United States through Canada See map of CANADA

ALBANIA is a small mountainous country in the Balkans adjacent to Greece and Yugoslavia on the Adriatic The capital is Tirana See map of the BALKAN PENINSULA

ALBERT, Prince See VICTORIA and PRINCE CONSORT

ALBINO, an animal or person with white hair and pink eyes Partial albinos may occur Albinism is inherited See HEREDITY

ALBUMENS, a class of PROTEINS which dissolve in water One is found in the white of egg

ALCHEMY is primitive CHEMISTRY characterized by the search for the Philosopher's Stone which was supposed to turn base metals into gold, for the Elixir of Life to prevent the ills of old age, and for the Alkahest, supposed to dissolve all substances Much of the alchemists' science would now be called conjuring and magic, but from their experience they obtained informa-

tion, particularly upon the burning and combining of substances, which led to the more exact and reliable theories of modern chemistry

ALCOHOL is a simple organic compound (see MIXTURES AND COMPOUNDS), usually made from sugar or starch by the action of yeast It is the intoxicating part of wines, beers and spirits It is also a good SOLVENT and is used in varnishes and medicines

ALCOTT, Louisa M See AMERICAN LITERATURE

ALEXANDER THE GREAT. See ANCIENT WORLD

ALFRED (849-901), son of a King of Wessex, is one of the noblest kings known to history He was born at Wantage (Berkshire), and when only four years old was taken to Rome He became King of Wessex in A D 871, at a time when the Danes had overrun the north and east of England, and were threatening Wessex In that year the West Saxons had fought nine battles, and for a time were left in peace In A D 878 the Danes made a sudden attack on Wessex during the Christmas festival, and Alfred had to take refuge for a time in the marshes of Somerset, where he made a fort on the Isle of Athelney During the winter Alfred made his plans, and in the spring he sent out messengers by secret paths to summon the men of Wessex to an appointed meeting place He then led an attack on the Danes, and defeated them at Ethandune (Edington) in Wiltshire Soon afterwards Guthrum, the Danish leader, signed the Treaty of Wedmore by which the Danes agreed to keep within the territory (the Danelaw) they had conquered, leave Wessex alone, and become Christians

When Alfred had secured peace for his people, he began to repair the ravages of war He built schools,

and brought teachers from the Continent. He improved the towns, and built fortified posts (burghs) on the frontier of the Danelaw. He had the good old Saxon laws written down and added new ones. In order to prevent further Danish attacks, Alfred built a hundred ships, longer and swifter than those of the Danes. He was "the Father of the English Navy," and his ships defeated and captured a Danish fleet in the River Lea. Alfred also organized a national army called the fyrd, which he divided into two parts, so that while some men were on military service for a time, other men were looking after the fields and crops, till their time came to serve.

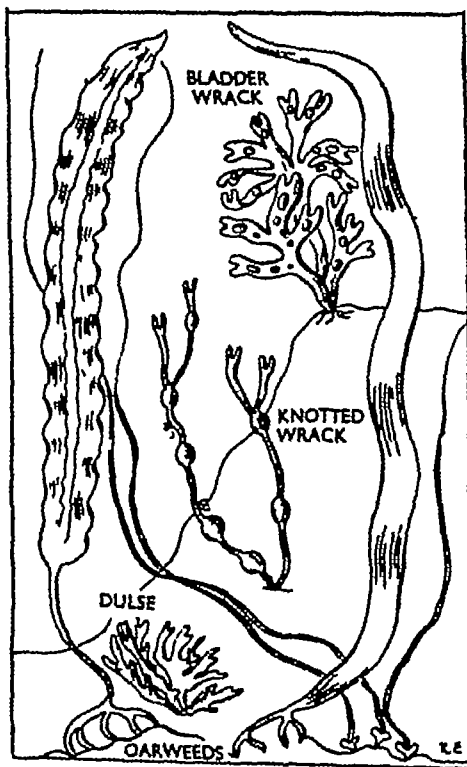
Alfred found time to write books, and translate others, including Bede's *Ecclesiastical History*, from Latin into English. He caused a record of events in England to be written in English—this was *The Anglo-Saxon Chronicle* and it was carried on for more than a hundred years after his death in A.D. 901. In every way he deserved his title—Alfred the Great. See **ANGLO-SAXONS**, and **ENGLISH LITERATURE**.

ALGAE are the simplest and lowest plants. They include microscopic plant cells floating in fresh or salt water, thread-like fresh water weeds and seaweeds. None of them has flowers, true leaves, or roots. The minute floating plants are important as food for small floating animals which in turn are the food of herring and other fish. The thread-like algae often grow so densely in lakes that they form mats of blanket-weed or flannel-weed. Many kinds of brown, green and red seaweeds grow between tide-marks or in deeper water.

ALGEBRA is a method of calculating with letters instead of numbers, used when we have not all the

exact figures necessary to do the sum. Algebra cannot give a precise result in a particular case, as arithmetic does, but it can give a general formula which will apply to every case, so that if some of the quantities in the sum are known, the others can be found. For example, if we know that 86 people are in a train, 46 get in and 34 get out, we can find out how many are left in by arithmetic $86 + 46 - 34 = 98$. If we do not know the numbers getting in and out, we can give letters to the numbers we do not know $86 + x - y$, but this will not tell us how many are left.

On the other hand, take a triangle whose area we want to find. Suppose we know the height and the base. We find that the area of a triangle is half the base times the height (see **TRIANGLE**), and if we call the height h and the base b , we can say that the area of every triangle is



Seaweeds are one kind of alga

§bh There are hundreds of algebraic formulas that can be used in this way. When adding or subtracting in algebra we can add or subtract only the same kind of terms. For instance, $2b + b$ can be written $3b$, but $2b + 3c$ has to be written $2b + 3c$. Here is an example of an algebraic sum.

Add $3x + 2y + b$, $14x + y - b$, $x + y + b$. First arrange similar expressions under each other, then proceed as in arithmetic.

$$\begin{array}{r} 3x + 2y + b \\ 14x + y - b \\ x + y + b \\ \hline 18x + 4y + b \end{array}$$

Suppose we multiply $(n + m)$ by itself

$$\begin{array}{r} n + m \\ n + m \\ \hline n^2 + mn \\ mn + m^2 \\ \hline n^2 + 2mn + m^2 \end{array}$$

(See **POWERS AND INDICES** for further information about n^2 .)

We now know that the square of $(n + m)$ equals the square of each term plus twice their product.

When we multiply $(n + m)$ by $(n - m)$ we get

$$\begin{array}{r} n + m \\ n - m \\ \hline n^2 + mn \\ - mn - m^2 \\ \hline n^2 - m^2 \end{array}$$

In other words, the sum of two quantities multiplied by the difference between them equals the difference between their squares. If, therefore, we want to find the difference between 25^2 and 16^2 , we need not find the squares and sub-

tract by arithmetic. We know that the answer is $(25 + 16)(25 - 16) = 41 \times 9 = 369$.

The early stages of algebra can help or replace arithmetic, but its advanced stages solve problems with which arithmetic could not deal.

See **EQUATIONS, FACTORS, FORMULAS, POSITIVE AND NEGATIVE, POWERS AND INDICES, SERIES**.

ALGERIA is a French North African region consisting of part of the Atlas Mountains and the coastal strip to the north, and a great desert area behind. Dates, iron-ore and wine are exported through the ports of Oran and Algiers, the capital. It consists of three departments, Algiers, Oran and Constantine, which form part of France, and the Southern Territories. See map of **AFRICA**.

ALIEN, a person who is not a subject of the country in which he is staying. If a foreigner wishes to become a British subject, he may, after five years' residence, apply to the Home Office for permission to become naturalized. If permission be granted, he then enjoys all the rights and privileges of a natural-born subject.

ALIMENTARY CANAL, a tube acting as a digestive tract (see **DIGESTION**) and the glands connected with it, about 30 feet long in human beings. Alimentary canals are present in all animals from worms upwards. In mammals the entrance, the mouth, contains the teeth and tongue, and the openings of the salivary glands. This leads to a muscular tube, the gullet or oesophagus, which swells out at the stomach. A circular muscle, opening only when food passes through, connects the stomach with the small intestine. The first loop of this is the duodenum, into which open ducts from the liver and pancreas. The bile-duct leads from the gall-bladder, into which flows bile.

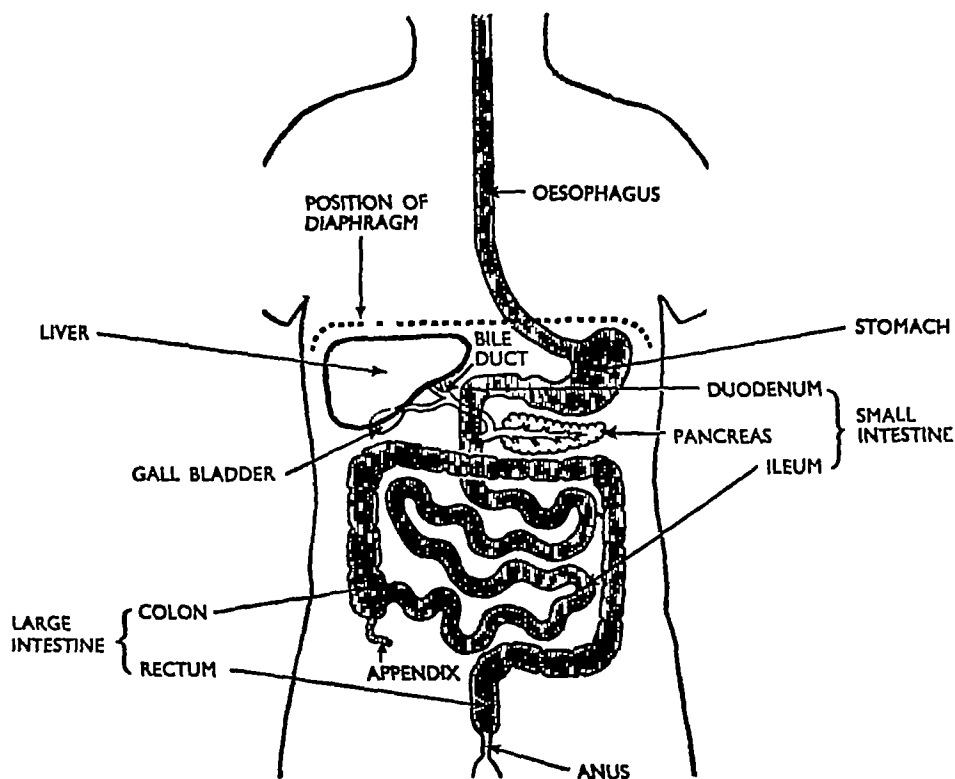
formed in the large liver lobes Long coils of the ileum follow, and at its junction with the colon, the first part of the large intestine, is the vermiform (worm-shaped) appendix The rectum follows the colon, and it ends with another circular muscle at the anus, the end of the alimentary canal

In rabbits, the appendix is at the end of a large tube, the caecum,

ALKALIS are substances which turn LITMUS blue, and neutralize an ACID They are often corrosive Common alkalis are caustic soda, caustic potash and also lime

ALLEGORY is a story which carries two meanings, the less obvious meaning being usually of some moral significance, as in *The Pilgrim's Progress* or the PARABLES

ALLIGATOR See CROCODILE



The alimentary canal, in which our food is digested

which is used for digesting grass (in human beings it has degenerated to its present size and serves no useful function) The small intestine may be one hundred feet long in a cow, its stomach is made of four bags instead of one, in which the grass is digested in successive stages So it and its grass-eating relations have barrel-shaped bodies to contain the long gut, while flesh-eating animals have shorter canals, and therefore slim bodies, like cats

ALLITERATION. See IMAGERY
ALLOTMENT GARDENING.

When land is divided into strips for the purpose of cultivation, each portion is called an allotment The soil must be regularly tilled (dug, hoed, ridged and raked) and manured if good results are to be obtained See DIGGING, HOEING, MANURING, ROTATION OF CROPS, COLD FRAME and GARDENING TOOLS

ALLOY, a metallic material made by mixing a metal with one or more

other substances in order to obtain a material of some desired hardness, strength, flexibility or other property. Common examples of alloys are brass (zinc-copper), bronze (tin-copper), steel (iron-carbon), stainless steel (iron, carbon and chromium), duralumin (aluminium, copper, magnesium, manganese and silicon). In some cases the components form a chemical compound rather than a mixture. See MIXTURES AND COMPOUNDS.

ALPHABET, the signs used to represent the simple speech sounds, so called from *alpha* and *beta*, the first two letters of the Greek alphabet. The English alphabet is derived chiefly from the Roman alphabet, which, in its turn, was adapted from the Greek. See also PHOENICIANS.

ALTAR, the table on which a SACRIFICE is offered. In some Christian churches, the table at the east end of the church is called the altar.

ALTERNATOR. See GENERATOR.

ALTITUDE is the height of a place or object above sea-level. Thus an aeroplane may be flying at an altitude of 10,000 feet.

ALUMINIUM is a metal chiefly important for its low DENSITY (2.7 grams per c.c.), its high conductivity for heat and electricity, and its softness. The last permits it to be worked easily. It is the basis of most light ALLOYS. It is now produced in large quantities by ELECTROLYSIS of molten BAUXITE and cryolite, in places where electric power is obtained from water turbines and is therefore cheap.

AMAZON, a great river of SOUTH AMERICA flowing eastward from the Andes to the Atlantic. It is 4,000 miles long and about 170 miles wide at its mouth.

AMAZONS, in CLASSICAL MYTHOLOGY, a warlike tribe of women

living in Asia. One of the twelve labours of HERCULES was to bring home the girdle of their queen, Hippolyta, who was to marry THESEUS, King of Athens.

AMERICAN LITERATURE.

The first American writer whose fame spread outside his native land was Benjamin Franklin (1706-1790) who wrote his *Autobiography*, but he had, in any case, lived in Europe. The same applies to Washington Irving (1783-1859), storyteller and essayist, who spent some time in England. He wrote on England, but his *Sketch Book* has some delightful tales and essays on his own country, including *Rip van Winkle*. Fenimore Cooper (1789-1851) shows in his novels, one of which is *The Last of the Mohicans*, a very great interest in Indian life and the pioneering days of the United States. In the 19th century the New England states were the centre of literary work, the leading spirit being Ralph Waldo Emerson (1803-1882), the essayist. A group of writers who looked up to Emerson included Thoreau (1817-1862), who turned to nature as an escape from man, an attitude expressed in *Walden*. Nathaniel Hawthorne (1804-1864) was a novelist, finding material in New England life of some generations before, which he used in *The Scarlet Letter*. Five other writers of fiction stand out—Herman Melville (1819-1891), whose *Moby Dick*, a tale of whaling life, is one of the classics of the sea, and Harriet Beecher Stowe (1811-1896), a leader of the anti-slavery movement, whose *Uncle Tom's Cabin* did so much to rouse feeling against slavery. Edgar Allan Poe (1809-1849) was a writer of powerful imagination, shown in his hair-raising *Tales of Mystery and Imagination*. Louisa M. Alcott (1832-1888) has won

fame by her children's stories, *Little Women* and *Good Wives* being the first of a series

Poetry about this time is represented by Poe, with short poems, including *The Raven*, but the leading poet was Henry Wadsworth Longfellow, whose *Hiawatha* tells of Indian life and customs. The most original poetry came from Walt Whitman (1819-1892), his *Leaves of Grass* shows experiment in form as well as energy of thought.

In prose Mark Twain—the pen-name of Samuel Clemens—(1835-1910) was undoubtedly the leading American humorist. *Tom Sawyer* and *Huckleberry Finn* are not only entertaining stories of children, but give a vivid idea of earlier and rougher days by the Mississippi.

American life naturally supplies material for most modern American writers. Novelists include Sinclair Lewis (b 1885) who writes satirical studies of small town life and society, such as *Babbitt* and *Main Street*, Upton Sinclair (b 1878) whose many novels are studies of social conditions, the most celebrated

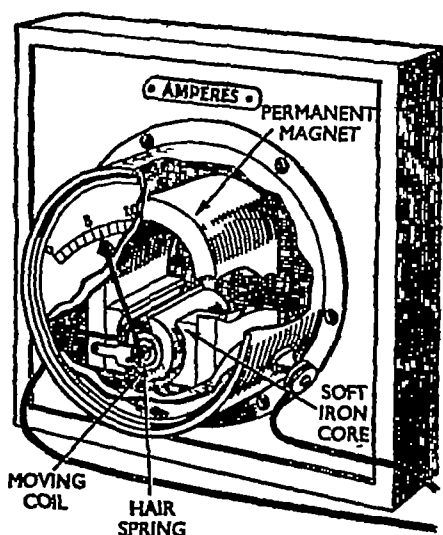
being *The Jungle*, intended to arouse the social conscience to the conditions of the workers in the Chicago meat industry, John Dos Passos (b 1896), who in *42nd Parallel*, has elaborated a cinema technique in story-telling by throwing together a number of scenes from the lives of his characters to achieve an effect of strain and restless movement. The best of them perhaps, is Ernest Hemingway (b 1898) who in the period between the World Wars represented a school of American writers concerned mainly with Europe, *A Farewell to Arms* being a novel of the First World War, while *For Whom the Bell Tolls* deals with the Spanish Civil War of 1936-1939. He has popularized the "tough" novel, self-consciously unsentimental. His style is the artistic use of matter-of-fact language to describe subtleties of character and situation. In drama the vigorous, highly original work of Eugene O'Neill (b 1888) has aroused wide interest.

AMMETER, an instrument to measure the rate of flow of CURRENT through an electrical circuit. It may be operated by either the magnetic or heating effect of the current.

A common type of magnetic ammeter as used for measuring the amperes of a current is shown. The moving part, a wire coil round a fixed core of soft iron, carries the pointer between the poles of a horse-shoe permanent magnet. A hair spring keeps the pointer normally at zero. The current to be measured passes through the coil which thus becomes a magnet and turns by the inter-



Huckleberry Finn, famous in American literature



Ammeter measuring current

action of its magnetism with that of the permanent magnet. The angle through which the coil turns depends on the size of the current. The bigger the current, the more the coil and its pointer move.

AMMONIA is a pungent gas supposed to have derived its name from the smell of dung outside the Egyptian temple of the god Ammon. It is very soluble in water. The ordinary household ammonia is a strong solution of the gas with a little soap added. It can be made from **SAL AMMONIAC** and lime, but is obtained commercially as a coal-gas by-product, or more often by the direct combination of nitrogen and hydrogen in the presence of a **CATALYST**. The chief uses of its compounds are for **EXPLOSIVES** and **FERTILIZERS**.

AMOEBAS, one of the simplest animals, living in fresh or salt water, soil, etc. It looks like a pin-head speck of greyish-white jelly. Under a microscope it can be seen to move and feed, which it does by flowing round its food and absorbing it. Instead of laying eggs or having young, it can divide itself to

form two distinct new amoebae **AMPERE**. See **ELECTRICAL ENERGY UNITS**.

AMPHIBIA are a class of vertebrate animals, including **FROGS**, toads and salamanders, which in the scale of **EVOLUTION** come between the **FISHES** and the **REPTILES**. The words "amphibian" and "amphibious" are applied also to certain animals of other groups which are at home both on land and in water, such as **SEALS** and **CROCODILES**.

AMYL ACETATE is a volatile **ORGANIC** liquid with a strong smell of pear-drops. It readily dissolves **CELLULOSE**, and is therefore used in many varnishes, nail lacquers and aeroplane fabric dope.

ANAESTHETIC, any substance which, when it is given to a patient, renders him unconscious or incapable of feeling a localized pain. A general anaesthetic such as chloroform or ether makes one unconscious, enabling a big operation to be carried out. A local anaesthetic such as novocaine enables a small operation such as tooth-pulling to be painlessly effected, while the patient remains fully conscious.

ANALYSIS. A chemist will be given a substance of unknown origin and be asked to identify it, or to find the proportions of the different materials of which it is composed. Experience will suggest to the chemist the exact way to approach the problem, and the method of analysis naturally depends on whether the substance is, for instance, a suspected human blood stain, the oil from a motor car, or the metal from a crashed aeroplane. Generally he will take the stuff as a whole and see how it behaves when heated or treated with various chemical reagents. Then he may try to break the substance up into all its constituents.

or even ELEMENTS, and find the properties of each one. He may examine the substance at any stage by SPECTROSCOPE or MICROSCOPE. When he has arrived at a final opinion as to the nature of the substance he will often attempt to rebuild the substance from raw materials. He will then find if the material built up is the same as that which he was asked to analyse. A substance is said to be analysed qualitatively when the object of the analysis is to find out what it is made of. A quantitative analysis is to find out how much of certain substances there is present.

See GRAMMAR for grammatical analysis.

ANAPAEST. See PROSODY.

ANATOMY is the study of the structure of the body. The arrangement of the organs which make up the MUSCLES, NERVOUS SYSTEM and other systems can be shown in dissection of dead bodies whose organs are carefully separated and displayed. Bone structure is studied by observing a SKELETON.

ANCIENT BRITONS. See BRITONS (ANCIENT).

ANCIENT WORLD is the name given to the world from the dawn of history down to the fall of the Roman Empire 1,500 years ago.

The story of the Ancient World is chiefly concerned with the rise and fall of great empires around the Mediterranean and in the valleys of the Nile, the Euphrates and Tigris. In world history it also includes the ancient lands of China and India which were then more civilized even than the West in those days.

The oldest of these empires is Egypt. About 3400 B.C., Menes, the first king known to history, united



Tutankhamen and Nefertiti

Upper and Lower Egypt. Five centuries later the vast monuments known as the pyramids were being built. Later kings of Egypt were buried in rock-tombs instead of pyramids. When the tomb of Tutankhamen (who died in 1340 B.C.) was opened in 1922, a wonderful collection of works of art was discovered, including the royal chair made of wood overlaid with gold, the mummy of this king was enclosed in a golden casket inlaid with precious stones, the face was covered with a golden mask and the head crowned with a royal diadem. Rameses II, another ruler (1292-1235 B.C.), was famous as the builder of the great temple to the Rising Sun (at Abu-Simbel), it is 185 feet long and 90 feet high and cut out of a sandstone cliff. This king may have been the Pharaoh who oppressed the Israelites and of whom we read in the Bible. Yet another famous ruler was Queen Nefertiti who reigned about 1370 B.C.

Egypt was conquered in turn by the Assyrians (671 B.C.), the Persians (525 B.C.) and Alexander the Great (332 B.C.). After Alexander's death, one of his generals, Ptolemy, became king of Egypt. The Ptolemy family ruled the land until the Romans conquered it in the time

of the famous Egyptian queen Cleopatra, the last of the Ptolemies. She was the friend of Julius Caesar, and after his death, of Mark Antony, but when Egypt was invaded by Octavian, she committed suicide.

Other empires grew up on the great plain watered by the rivers Euphrates and Tigris. The earliest was the Sumerian Empire, conquered by Sargon I, a leader of nomadic tribes (2750 B.C.). About six centuries later, Amorites from Syria established themselves in a little village called Babylon. Their king, Hammurabi (about 2000 B.C.), conquered the neighbouring tribes, and Babylon became the capital of a great empire; he lived about the same time as ABRAHAM of whom we read in the Bible.

Then the Assyrian Empire arose, it waged war with the Hittites, a tribe from Asia Minor who had conquered Syria, and who are said to have been the first people to use iron. The Assyrians conquered Babylon, made war on and defeated the Israelites and



Assyrian King

carried away captives. The Assyrian Empire was overthrown by Chaldeans, and once again Babylon became a great city. Its king, Nebuchadnezzar, besieged and took Jerusalem and carried the Jews into captivity in Babylon.

Next the Persians rose to power, and Cyrus the Great founded an empire. The Persians captured Babylon (539 B.C.), and allowed the Jews to return to Jerusalem.

Another famous people of the Ancient World were the GREEKS,

who set up a number of city-states. They were conquered by Alexander the Great, who also conquered Egypt and overthrew the Persian Empire. He occupied Babylon, and marched eastward into India, but had to return because of discontent among his soldiers. He died soon afterwards in Babylon, and his great empire was divided, and later conquered by the Romans.

ROMAN became the greatest power under Julius CAESAR. Later, Constantine (A.D. 306-337), the first Roman Emperor to become Christian, built a new capital on the Bosphorus, choosing the site of an old Greek fortress named Byzantium. The new city was called Constantinople, "the city of Constantine." Later the Roman Empire was divided (A.D. 395), Rome remained the capital of the west, and Constantinople the capital of the Eastern (Byzantine) Empire, which was more Greek than Roman. The Empire in the West fell about A.D. 476 before the attacks of many barbarian tribes—when Roman Britain was also attacked by the barbarian Angles and Saxons. But in Constantinople, Greek books and works of art were preserved for a thousand years. When the city was at last taken by the Turks (1453), these precious relics of Greek learning and culture were removed to Italy, and played a great part in the RENAISSANCE, or Revival of Learning, in Europe. See also SEVEN WONDERS OF THE ANCIENT WORLD.

ANDERSEN, Hans Christian (1805-1875), was a Danish poet, novelist and playwright, now world-famous for his fairy tales, which he himself thought unimportant. Among the best known of these are *The Ugly Duckling* and *The Emperor's New Clothes*.

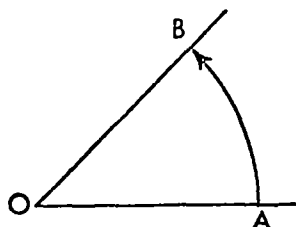
ANDORRA is a very small semi-independent country in the

Pyrenees, between France and Spain

ANDREW, St., brother of **PETER**, was one of the twelve apostles. Four of them, Peter, James, **JOHN** and Andrew, formed an "inner circle" of authority. St. Andrew was crucified at Patras in Achaea on a diagonal cross, which afterwards bore his name. He is the patron saint of Scotland and his festival is kept on November 30th.

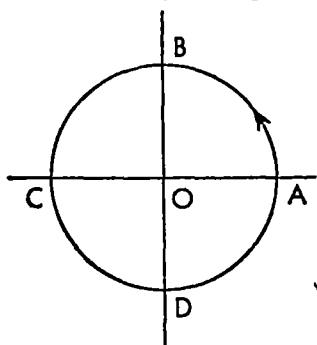
ANGEL, in Christian belief, is a messenger of God. The Bible refers to several ranks of angels, including cherubim, seraphim and archangels.

ANGLE, the amount of turning between one line and another which meets or crosses it. The angle AOB



is the amount of turning needed to move OA to OB .

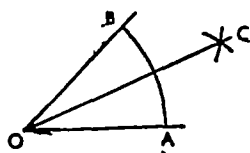
In the next case CA and BD are two lines crossing at right angles.



Each of the angles, AOB , BOC , COD , DOA is a right angle. There are 360 degrees (360°) in one complete turn (or revolution), so that a right angle is $360^\circ \div 4 = 90^\circ$. An angle of more than 90 degrees is called an obtuse angle, one of less than 90 degrees an acute angle.

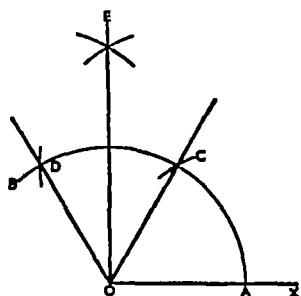
Two lines at an angle of 180 degrees will make one straight line.

To bisect an angle, with centre O draw an arc to cut the arms of the



angle at A and B . With the same radius and centres A and B , draw arcs which will cut one another at C . Join OC . There is an exact balance about OC and angle $BOC = \text{angle } AOC$.

To draw an angle of 60 degrees, draw a line OX and with O as centre draw the arc AB , with a radius equal to OA and centre A , draw an arc cutting the previous arc at C , join OC . Angle AOC is 60 degrees. To draw an angle of



30 degrees, draw an angle of 60 degrees and bisect it. For 15 degrees, bisect an angle of 30 degrees, and so on.

To draw an angle of 120 degrees, draw OX , and the arc AB . With radius equal to OA step off arcs AC , CD along AB . Angle AOD is 120 degrees.

To draw a right angle, draw an angle of 120 degrees. Bisect the part DC . Angle AOE is $120^\circ - 30^\circ = 90^\circ$.

ANGLO-EGYPTIAN SUDAN, an area around the Nile with SAVANNAH and desert to the west,

administered jointly by Great Britain and Egypt Chief exports are cotton, grown with the aid of irrigation from the Blue Nile's Sennar Dam, and gum arabic from trees in the savannah region Millet is the main food crop The chief towns are Khartoum, the capital, at the junction of the Blue and White Niles, and Port Sudan on the Red Sea See map of EGYPT

ANGLO-SAXONS, the various tribes from Northern Germany and Jutland who invaded Britain after the Romans left The Jutes arrived in the south-east (A D 449) The Saxons founded the kingdoms of Wessex, Sussex, Essex, Middlesex and Mercia The Angles founded the eastern kingdoms of Northumbria and East Anglia, and finally gave their name to the land—"Angle-land," or, as we say, England The Ancient BRITONS were driven westward into Cornwall, Wales and Cumberland, and across the sea to Brittany

The Anglo-Saxons lived in farms protected by a stockade and moat, eating and sleeping in the hall They were all heathens till St AUGUSTINE arrived in Kent (A D 597) and converted it to Christianity In time Christian missionaries from Iona and from Rome converted other parts of England The story of these Christian teachers, and of the Anglo-Saxon invasion, is told in the first English history book, written by the learned Bede (A D 673-735), a monk To him we owe almost all our knowledge of that period of the island's story

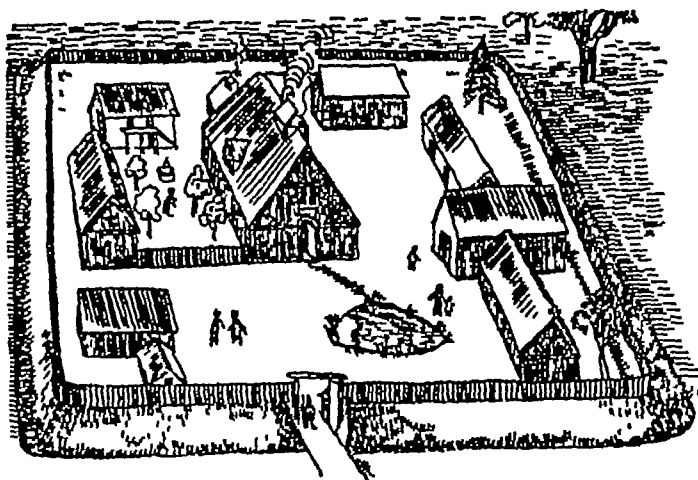
Various kings tried to make their kingdoms supreme over the rest The most successful was Egbert, king of Wessex, and Wessex maintained its supremacy throughout the rest of the Anglo-Saxon period Saxon kings were assisted in their

government by a council, known as the Witan (or "Wise Men") It had some of the powers of our Parliament, though it was not elected by the people It made laws, was consulted on questions of war or peace, and could even depose a king and put another in his place Many of England's laws and customs, as well as the language, have been handed down from these Anglo-Saxon ancestors

Towards the end of the 8th century the island was attacked by Vikings, "men of the camps," fierce pirates from Norway and Denmark (also called Danes and Northmen) They came in their long ships, and at first made raids, landing, robbing churches and monasteries, destroying villages, and then sailing away with their plunder In time they settled down, especially in the north and east of England, and ALFRED the Great made them promise to keep to their own territory, known as the Dane-law, east of Watling Street

Fresh Danish attacks began eighty years after Alfred's death King Ethelred II paid the Danes to go away, and imposed a tax (Danegeld = Dane money) for this purpose The plan failed, and Ethelred then ordered a massacre of Danes living in Wessex Because of this treachery the Danes made a great attack, Ethelred fled to Normandy, and finally a Danish king, Canute, added England to his Scandinavian Empire, reigning 1016-1035

Canute tried to repair the damage done by his countrymen to churches and monasteries He gave England nearly twenty years of peace, and divided the country into four great earldoms, Wessex, Northumbria, Mercia and East Anglia Canute was succeeded in turn by his two sons On the death of the second son, the Witan invited Edward, the



HOMESTEAD



WARRIOR



BOOK ILLUMINATIONS



CHRISTENING



INSIDE THE HALL
Scenes of everyday life in the time of the Anglo-Saxons

son of the last Saxon king, and known as the Confessor, to take the crown. After reigning twenty years, he died without heir, and his cousin, William, Duke of Normandy, claimed the crown. The Witan, however, chose Harold, Earl of Wessex, the late king's brother-in-law, as king. William invaded England, and Harold was defeated and slain in the Battle of Hastings (1066). So ended the long line of Anglo-Saxon kings, and WILLIAM THE CONQUEROR began to reign as the first of the Norman sovereigns.

ANILINE is a colourless oily liquid manufactured from nitrobenzene. It is a raw material from which many dyes and drugs are built up.

ANIMAL. Every living thing is either a plant or an animal, though some such as viruses, BACTERIA and FUNGI are difficult to classify. The animal kingdom ranges from single creatures too tiny to be seen without a microscope up to man himself and includes all types between the two extremes. Every animal depends on plants for its food, since even if it eats other animals, these in turn feed on plants.

ANNE (reigned 1702-1714), last of the Stuart sovereigns, was daughter of James II. She was born at St James's Palace, London, in 1665. She married (1683) Prince George of Denmark. Only one of her many children lived beyond infancy, he was the Duke of Gloucester, but he died when eleven years old.

Anne became queen on the death of her brother-in-law, William III, in 1702. A leading event of her reign was the Union of the Parliaments of England and Scotland (1707). It was also a time of bitter political strife between the two parties, the **TORIES** and **WHIGS**.

On the Continent, the War of the Spanish Succession was being

fought, in which the English general, John Churchill, created Duke of MARLBOROUGH (ancestor of Mr Winston Churchill), won the brilliant victories of Blenheim, Ramillies, Oudenarde and Malplaquet. At home, many famous writers were at work—ADDISON, Steele, POPE, Dean SWIFT (the author of *Gulliver's Travels*). The great German musician, George HANDEL, came to live in England.

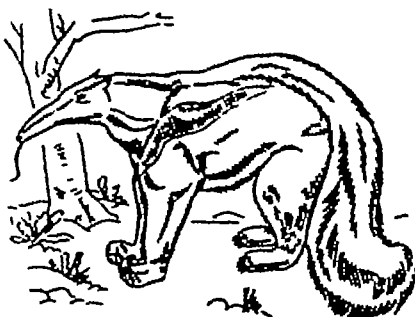
Queen Anne was a gentle, kindly woman, but was for many years under the powerful influence of Sarah Churchill, Duchess of Marlborough. In 1710 the two quarrelled, and the queen found a new favourite in Mrs Masham, a cousin of the duchess. This change gave more power to the Tory Party. The queen was anxious to make her half-brother, James Edward (Stuart), her successor, but on her death in 1714, the Protestant Elector of Hanover, her cousin, became king as George I, the first of the Hanoverian kings from whom the present king is descended.

ANNUALS are plants which grow from seed, flower and die all in the same year, e.g. asters, candytuft, clarkia, stocks, sweet peas.

ANT. See **BEE**.

ANTARCTIC. See **ARCTIC**.

ANTEATER. True anteaters, as well as the **ARMADILLO** which is related to them, live in South



Anteater of South America

America. Pangolins of Asia and Africa are also ant-eating mammals. Ant-eaters possess powerful claws for digging into ant-hills and tongues of amazing length. See also AARD-VARK.

ANTELOPE. See HOOFED MAMMALS.

ANTHER. See FLOWER.

ANTI-BIOTICS. MOULDS and BACTERIA often grow together, feeding on the same materials, and it has been shown that many of these organisms produce chemical substances which interfere with the growth of their competitors: we call such substances "Anti-biotics". Penicillin is an example of an anti-bacterial substance produced by a mould.

Anti-biotics have been known for many years, and attempts to use them to destroy harmful bacteria in the human body were made from time to time. But little progress was made until the discovery of penicillin in 1929 by Professor Sir Alexander Fleming. A particle of mould accidentally entered a culture of bacteria and Professor Flem-

ing noticed that bacteria near the mould died off. He discovered that this mould was a relatively rare one, named *Penicillium Notatum*, and further research disclosed that the chemical substances which it produces destroy many bacteria harmful to man, yet it does not hurt the human body.

The Second World War stimulated research on penicillin, as it was named, and scientific workers found how to produce it on a commercial scale, purify it, and treat infected persons with it. Foremost among the experts were Professor Sir Howard Florey, who introduced penicillin to clinical medicine, and Dr E. Chain, who began the study of its chemical nature.

ANTI-CYCLONE. See CYCLONE.

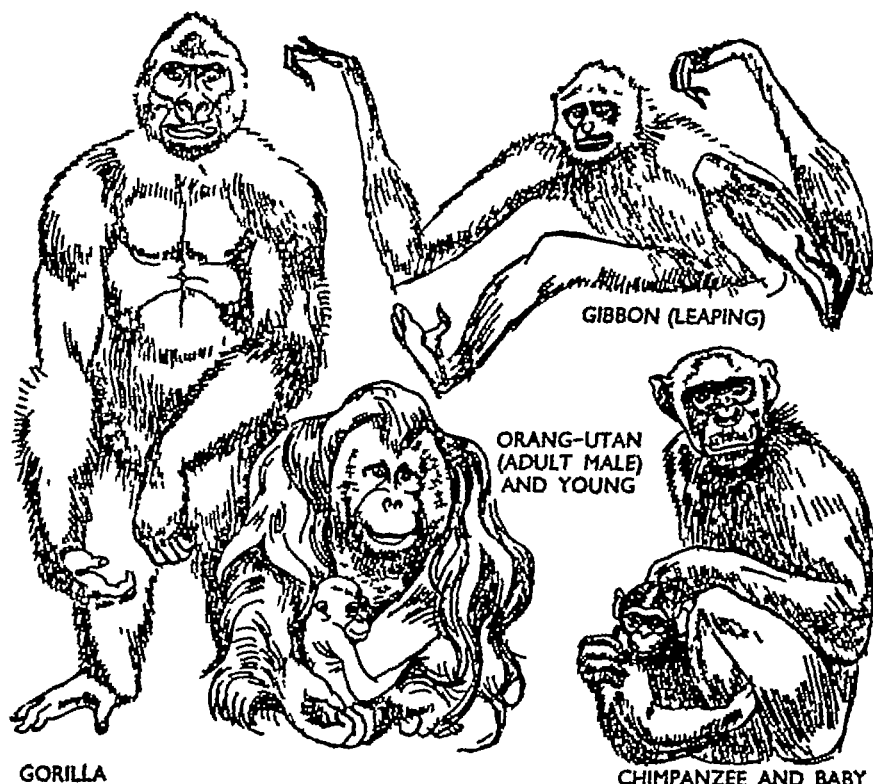
ANTIPODES. If a line is drawn from any point A on the earth's surface through the centre of the earth and continued to the opposite side to point B, then point B is said to be the antipodes of point A. The antipodes of London (lat. $51\frac{1}{2}$ deg N, long 0 deg) is lat $51\frac{1}{2}$ deg S, long 180 deg, in the Pacific Ocean.



Fleming discovered penicillin



Florey used it for healing



Apes are the animals most nearly related to ourselves

to the south-east of New Zealand

ANTISEPTICS are substances which, when applied as in a washing or dressing for a fresh wound, check the growth of harmful **BACTERIA** See **LISTER**

ANTITHESIS See **IMAGERY**

APE The tailless apes, with the monkeys, belong to the highest group of **MAMMALS**, and are most nearly related to man They include the gorilla, orang-utan, chimpanzee and gibbon Two types of gorilla live in Central African forests Male gorillas may be 6 feet in length and weigh 400 lb Gorillas live a roaming life in family parties, and are usually inoffensive unless disturbed The orang-utan of Malaya is the second largest ape It has long, reddish-brown hair and lives in trees, where it builds nests of branches In cap-

tivity the adults grow surly and uncertain in temper A smaller black ape, the African chimpanzee, is famous as a pet, its young are almost child-like in their ways, while the grown-up animals are sociable and good mimics The smallest apes are the slim, long-armed gibbons of the Far East They are fond of community howling, and can cover 30 feet at a swing as they hurl themselves through the jungle trees Apes are largely vegetarian, eating fruits, leaves and shoots See **MONKEY**

APHRODITE is the Greek name for **VENUS**

APOCRYPHA, ancient Jewish religious literature not considered genuine by the Jews At the **REFORMATION**, the Protestants did not think that these writings were

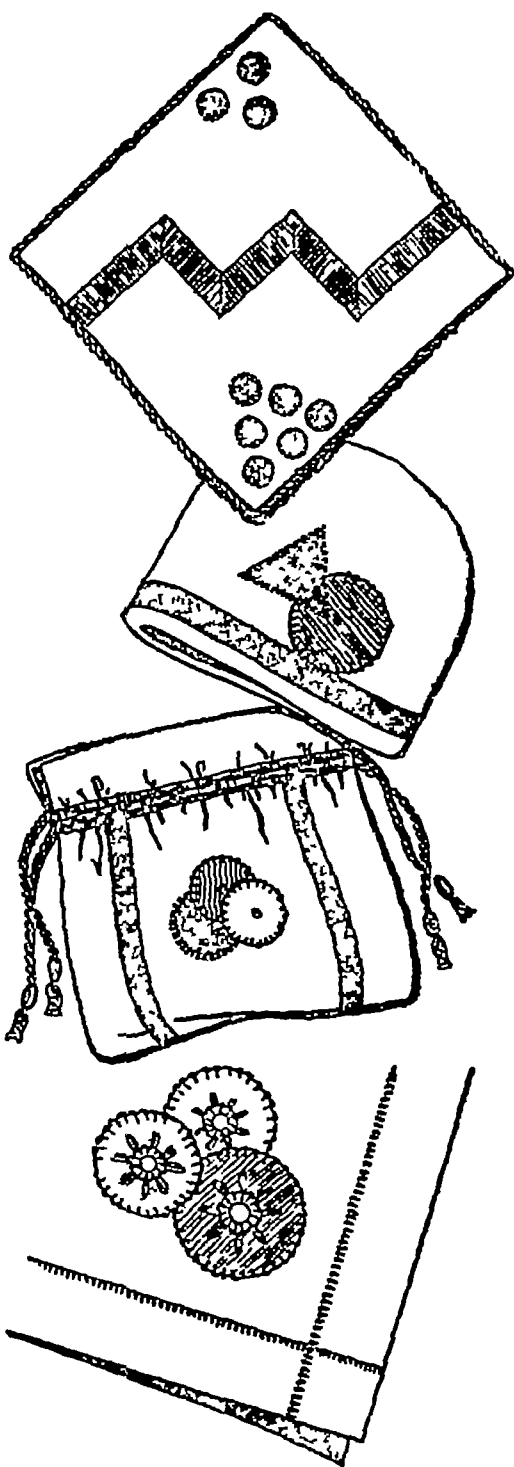
divinely inspired, and they are therefore very often issued separately from the Protestant translations of the BIBLE

APOLLO, in CLASSICAL MYTHOLOGY, is the sun god, also god of music and the fine arts He had an oracle at DELPHI

APOSTLE means a messenger, and is used in reference to one who preaches the Christian faith The Twelve Apostles were the principal disciples sent by Jesus to spread his religious doctrine amongst the people They were Simon (surnamed PETER), ANDREW, James the son of Zebedee, and his brother JOHN, Thomas, Philip, Bartholomew, Matthew, Simon the Canaanite, Judas Iscariot, James the son of Alphaeus, and Thaddaeus Matthias later took the place of Judas Iscariot, and Paul (Saul of Tarsus) joined them after his conversion

APPLIQUE is decorative needlework in which one material is sewn on to another to form a pattern Simple, bold designs give the best result In the simple design shown at the bottom of the illustration, circles of material, with coins for patterns, have been used The applied pieces must be placed so that the warp and weft of the material fit those of the background to prevent wrinkling Each shape is pinned in position, then tacked If the applied material is thin and the design simple, turn in and hem all the edges On thicker material sew the edges down with BUTTONHOLE or BLANKET STITCH Felt and leather do not fray, so their edges need no other protection

APPRENTICESHIP is a period of practical training in a trade or calling, as agreed between an employer and a parent on behalf of a child, to be given by the employer to the apprentice, the parent undertaking to see that the contract is



Here are some examples of appliqué Pieces of material are sewn on to a background to form decorative patterns Simple designs, such as these, can give a striking and original effect

observed by the apprentice Usually apprenticeship was considered a privilege for which the parent had to pay the employer a sum of money called a premium The practice has almost disappeared from trade, but continues in some professions such as law and accountancy

APPROXIMATION is the expression of a quantity in round figures when exactness is not desired We may reach an approximation to whatever degree of accuracy is convenient for our particular purpose Here are three examples

(1) 38,527 If we want the nearest 10,000, we call this 40,000, it is nearer to 40,000 than 30,000 If we want the nearest thousand, we call it 39,000 If we want the nearest hundred, we call it 38,500 If we want the nearest ten, we call it 38,530

(2) 08352647 To two places of decimals this is 08, to three places it is 084, to four places it is 0835, to five places it is 08353, to six places it is 083526, to seven places it is 0835265

Note that when the following figure is *five* or more the number above is taken, when it is less than *five*, the number below

(3) £8,762,076 14s 9½d To the nearest million pounds this is £9 millions, to the nearest thousand it is £8,762,000, to the nearest hundred it is £8,762,100, to the nearest pound it is £8,762,077 (as 14s 9½d is nearer to £1 than to 0d), to the nearest penny it is £8,762,076 14s 10d Sums can sometimes be worked out with sufficient accuracy by neglecting the last few digits, but it must be remembered that in multiplication every inaccuracy will also be multiplied See **SIGNIFICANT FIGURES**

AQUARIUM, a tank of glass or other material in which living water

plants and animals are kept It should have two inches of sand or gravel at the bottom, and contain plants such as eel grass, arrowhead, fanwort, ditchmoss, or stonewort



Aquarium with fish and plants

The tank should be so placed that it receives no more than one hour of direct sunlight daily

A Zoo aquarium, however, is usually a collection of tanks of fresh and salt water fish and other animals on view

ARABIA is a great plateau along the Red Sea consisting of five countries, the largest of which is Saudi Arabia The others are Yemen, Kuwait, Oman, and the ADEN Protectorate Most of the country is desert inhabited by nomadic Bedouins In some areas

irrigation makes possible the growing of grain, vegetables and dates. The most important towns are Mecca, the holy city of the Moslems, and Riyadh, capital of Saudi Arabia. See map of the NEAR EAST.

ARABIAN NIGHTS ENTERTAINMENTS, a collection of stories in Arabic, drawn probably from Indian and Persian as well as Arabic sources, and first translated into English in 1840. The stories, which include *Aladdin Ali Baba and the Forty Thieves* and *Sindbad the Sailor*, are fitted into a framework which is itself a story of a king who killed his wives the day after their marriage, until one wife, Scheherazade, put off her execution from day to day by telling him a new tale each night.

ARBITRATION is a method of settling a dispute by referring it for decision to some disinterested person or persons. It is the method frequently used in disputes between employers and employees, the arbitrators often being employers and workers from other industries. The method has also been used occasionally to settle disputes between nations. See **LEAGUE OF NATIONS** and **UNITED NATIONS ORGANIZATION**.

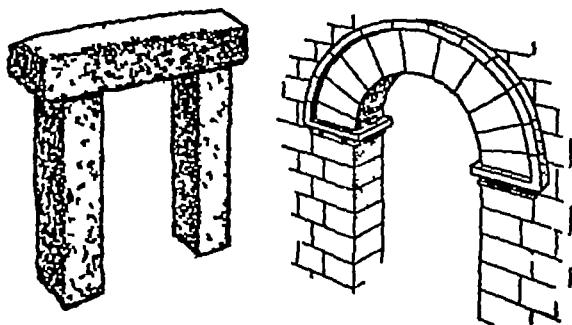
ARCH. The earliest buildings had their roofs supported by slabs of timber or stone laid upon and between two piers or columns. Stone slabs, however, are easily

cracked by weight laid on top, and wooden beams, though less brittle, are better able to carry the weight of a cottage than of a church. The arch was devised to enable greater weight to be carried above, wider gaps to be spanned, and higher roofs to be built. The sides of an arch are roughly like the sides of a U turned upside down. These sides are built up by a series of wedge-shaped blocks, one on top of the other, each projecting a little way beyond the one beneath so that the two sides eventually meet at the top. Since stone is very strong when compressed, and this is the state of all the parts of the arch, we see that we can, by using an arch, support a heavy weight over a wide opening such as a doorway, and yet use only quite small blocks of stone instead of the huge single slab which would otherwise be required. See **BRIDGE**.

ARCHAEOLOGY is the study of antiquities, especially those of the far-off times before the tale of history began to be written, and it is through excavations and the study of remains of the past that a knowledge of ancient peoples and nations has been obtained.

The primeval world has been divided by archaeology into three periods, namely, the stone, the bronze and the iron ages, and they derive their names from the material of which weapons, tools, etc., were made.

The **STONE AGE** which began about 50,000 years ago has been subdivided into the Old Stone Age and the New Stone Age. The people of the New Stone Age, which began about 12,000 years ago, made their weapons and tools sharper and more polished than did the men of the Old Stone Age.



Stone slabs replaced by the arch

Following the Stone Age was the Bronze Age, between 3,000 and 4,000 years ago, when people learned how to use first copper for the making of things and then bronze, after discovering how to produce bronze from copper and tin

The Iron Age was the period when people began to make implements of iron. It began about 3,000 years ago

In archaeological research stone and bronze remains have frequently been found along with those of iron. Consequently it has been deduced that one type of implement did not cease to be made and used as soon as a new medium was introduced

ARCHIMEDES was a Greek scientist of the 3rd century B.C. who was interested in all branches of science, but particularly in mechanics, being influenced by the study of the small war machines and boats which were then used. He is remembered now by his principle which states that "the upthrust on a body immersed in a fluid equals the weight of the fluid displaced by the body." This explains why a ship floats high in the water in dense, cold sea-water and low in fresh water or warm sea-water, which is less dense, although the total weight of the ship still remains the same. See **PLIMSOLL LINE**

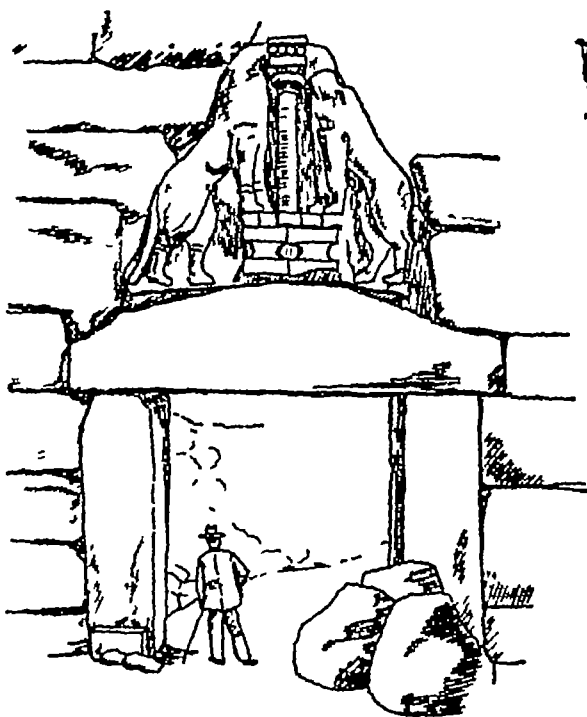
The **BALLOON**, too, goes up because the weight of the air it displaces gives an upthrust greater than the total weights of the basket, cargo, gas-bag and the gas which fills it out. The **HYDROMETER** rises or sinks in liquids of different densities because, being of constant weight, it displaces different volumes, though the same weight, of the liquids. See **SPECIFIC GRAVITY**

ARCHIPELAGO is any considerable group of islands, such as the islands of the **WEST INDIES**

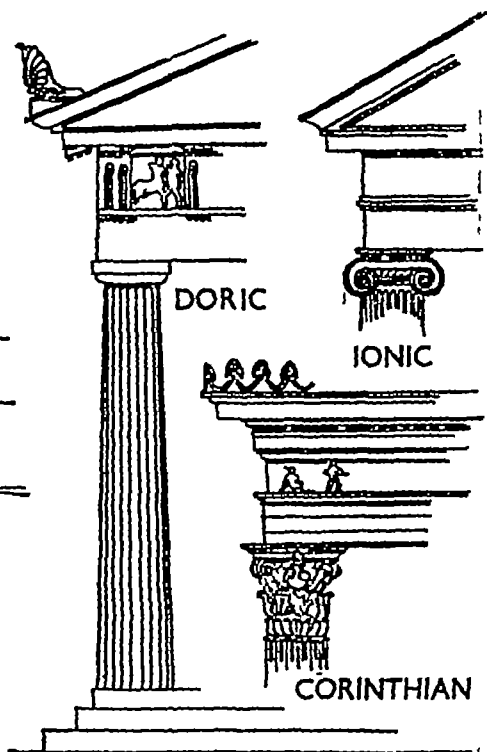
ARCHITECTURE is the planning and construction of buildings which not only fulfil their purpose but are also pleasing to look at. The architect must plan the size and proportions of the various parts—walls, rooms, windows, doors, roofs, and so on, so that all of them separately are of the right size and shape for their function and will yet form a pleasant harmony when viewed as a whole

Types of architecture may be divided into three large groups, each distinguished by a special method of construction, and each taking a distinct place in history. The differences between them are most marked in their methods of enclosing space—their treatment of roofs, windows, doors and so on, and they also vary according to climate, materials and the development of man's ideas and his spiritual and physical desires

(1) The first is distinguished by its method of bridging space by beams of wood or long flat blocks of stone. It is sometimes called the **Lintel Group** or the **Column and Pediment Group**. These flat blocks, or lintels, had to be supported on uprights—pillars or columns as they are called—placed at distances apart to suit the length of the lintels. We find this method very early in history, a good early example being the Lion Gate at Mycenae in Greece, built about 2000 B.C. The Greeks brought this method to perfection in their temples, the finest example being the Parthenon at Athens, built in the age of Pericles, 460-429 B.C. The Greeks were not only artists with a fine sense of beauty, but were a highly intellectual people who reasoned out everything they did. They created several styles of architecture marked by differences in the design of the pillars or columns and in the



EARLY GREEK GATE

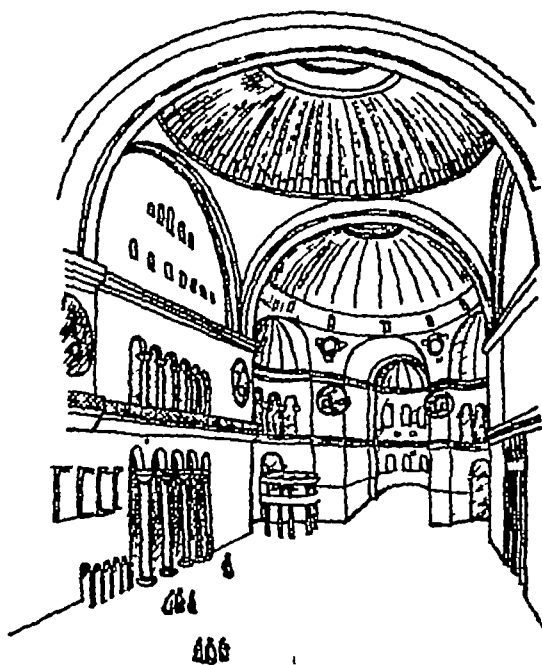


DORIC

IONIC

CORINTHIAN

GREEK COLUMNS

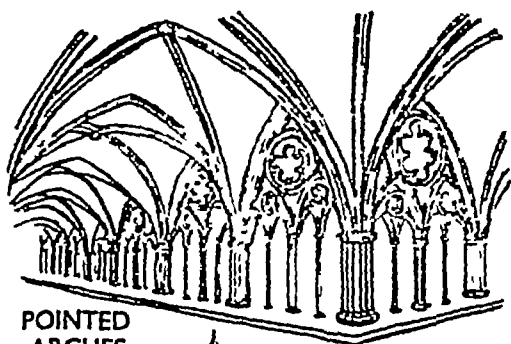


BYZANTINE CATHEDRAL

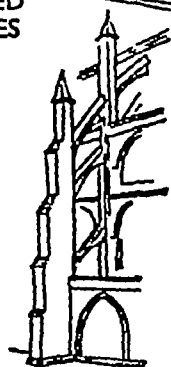


ROMANESQUE CHURCH

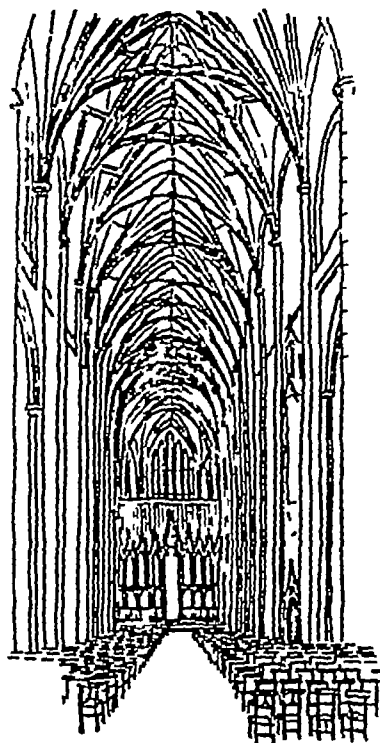
Architecture is the art of enclosing space—the examples above



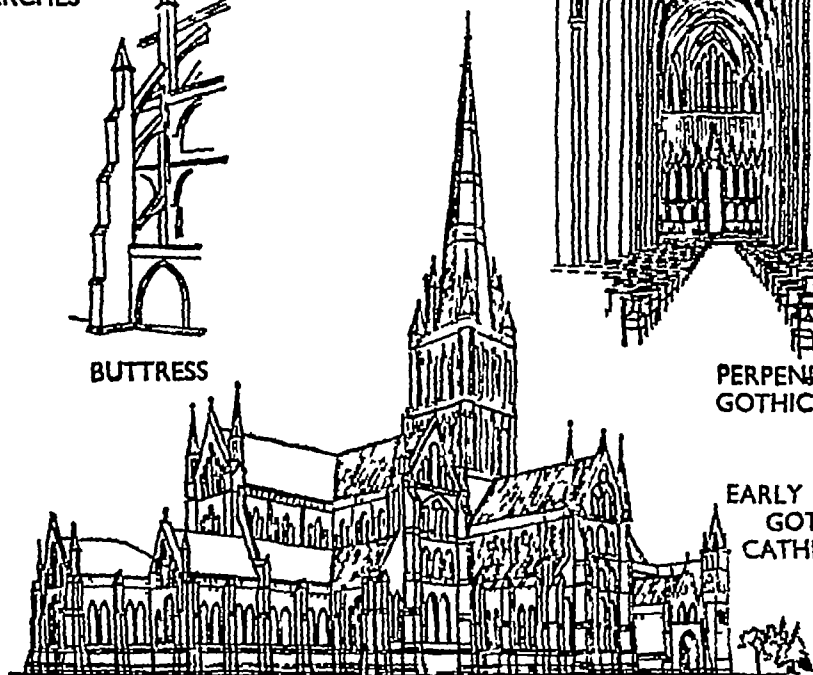
POINTED
ARCHES



BUTTRESS



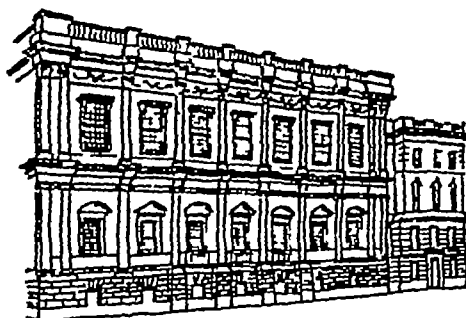
PERPENDICULAR
GOTHIC NAVE



EARLY ENGLISH
GOTHIC
CATHEDRAL



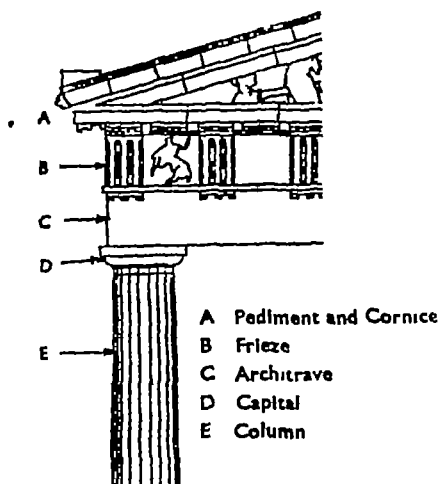
ELIZABETHAN
HOUSES



RENAISSANCE STYLE HALL

from different periods show features of the various styles

forms of entablature (the architrave, frieze, cornice, and pediment or triangular erection above) which the pillars supported. The styles take their names from the pillars,



Entablature in Greek Architecture

namely, the Doric column, the Ionic and the Corinthian (See p 34)

(2) The second group is marked by the invention and development of the semi-circular arch, made from stones cut and placed so that they lock and press together as they rise to make an ARCH or dome. This method was used in Mesopotamia by the Assyrians and Babylonians as far back as 3000 B C, but it was in Roman times that the style became popular, resulting in buildings with many arches, vaults and domes. From Italy the Roman forms of architecture spread east and west. In the new capital of the Roman Empire founded by the Emperor Constantine in the 4th century it took on an Eastern flavour in the great church of Saint Sophia in Constantinople. This church is characteristic of Byzantine architecture (Byzantium was the old name of Constantinople), which spread all over Eastern Europe.

In the West we find the Roman style merging with the Anglo-

Saxon and Norman, a form that is called Romanesque. The Norman style shows its Roman influence very clearly in Earls Barton Towers, Northumberland, and in Iffley Church, Oxfordshire. The main feature is the sturdy Norman pillars or piers supporting the Roman arch.

(3) The third group is called Gothic and is easily distinguished by the pointed arches, pinnacles and spires which were supported by buttresses built outside the walls, and clustered pillars (instead of single columns) supporting towering arches and vaulted roofs. Gothic architecture was introduced into Europe in the 12th century and was extensively used for churches and cathedrals during the 13th and 14th centuries. The first pointed arch in England appeared at Fountains Abbey, built in 1140-1150.

In England, Gothic architecture is itself divided into three periods: Early English, e.g. Salisbury Cathedral (13th century), Decorated, e.g. choir of Lichfield Cathedral (14th century); Perpendicular, e.g. Winchester Cathedral (nave 14th century).

It was revived in new forms during the 19th century, after the discovery of new materials such as concrete, and the combination of concrete and steel. This gave strength and lightness of construction and made possible the building of tall vertical blocks of great beauty and strength combined with domes and vaults of various shapes.

There have been, moreover, revivals, continuations and admixtures of all those three groups e.g. the Tudor style (15th and 16th centuries) composed of buildings which are really Gothic with Classical details added, and Renaissance or Italian style with Classical columns and façades, and no Gothic features, e.g. the Banqueting Hall,

Whitehall, by Inigo Jones, and St Paul's Cathedral by Sir Christopher Wren

Ordinary houses were for long made largely of wood, and good examples are the 16th-century Elizabethan houses still to be seen in many parts of the country

ARC LAMP. See **LAMP**

ARCTIC and **ANTARCTIC** are areas of land and ocean surrounding the North and the South Poles, lying north of $66\frac{1}{2}$ degrees North and south of $66\frac{1}{2}$ degrees South respectively. Parts have been explored but penetration inland is hampered by the severe climate and the ice. **SEALS** and walrus are the chief living creatures in the Arctic, and **WHALES** and **PENGUINS** in the Antarctic. The only vegetation is **TUNDRA**.

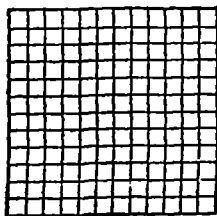
Various countries are interested in the lands and islands of the Arctic and Antarctic, and weather stations have been established at many points to obtain data to help in forecasting the weather for shipping and other purposes.

AREA is the amount of surface a plane figure covers. We reckon small areas in square inches or square centimetres (see **METRIC SYSTEM**). A square inch is the surface covered by a square with sides of 1 inch. An area of 1 square inch may be any shape, provided the amount of surface is the same. Larger areas are measured in square feet and square yards, and very large areas in square miles.

A foot square may be divided into $12 \times 12 = 144$ square ins (See the diagram)

1 square yard
 $= 3 \times 3 = 9$ sq ft

1 square mile
 $= 1,760 \times 1,760$
 $= 3,097,600$
square yards,



See **CIRCLE**, **MENSURATION** and **VOLUME**

ARES is the Greek name for **MARS**

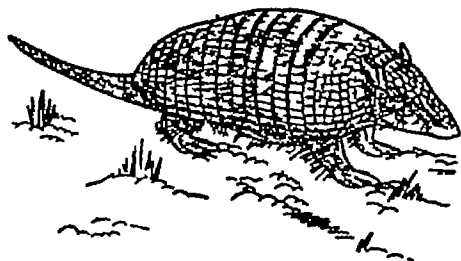
ARGENTINA is a temperate South American republic where sheep, cattle and horses are grazed on huge ranches and wheat and maize are grown. Canned and frozen meat, wool, and cereals are exported. The Gran Chaco swamps to the north and the arid Andean slopes are very sparsely populated, and most of the people live around the estuary of the River Plate. The chief towns are Buenos Aires, capital and port, Rosario, Cordoba, and the ports of Bahia Blanca and La Plata. See map of **SOUTH AMERICA**.

ARGONAUTS are the Greek heroes who sailed in the ship *Argo*, under **JASON**, in search of the **GOLDEN FLEECE**, according to **CLASSICAL MYTHOLOGY**.

ARISTOPHANES (about 444—about 380 B C) was a Greek writer of satiric comedies which deal bitingly with affairs and personalities of his day, among them are *The Birds*, a political satire, and *The Frogs*, a burlesque of the work of **AESCHYLUS** and **EURIPIDES**.

ARISTOTLE (384–322 B C), Plato's pupil and tutor to Alexander the Great, is the Greek writer whose ideas have most profoundly influenced later European thought, as it was on his philosophy that the Church in the Middle Ages founded its own system of philosophy. He ranged over wide fields of knowledge, including science, poetry and politics, and was one of the first to study systematically the world of nature. His *Ethics* and *Poetics* are among the best known of his surviving works.

ARMADILLO, a small burrowing **MAMMAL** with jointed armour plating of bony scales on its back, enabling it to curl into a very well protected ball if alarmed. It feeds



The armadillo has a tough back

on ants, grubs, worms, reptiles, carrion, etc. It is a harmless creature and is found in Central and South America.

See also ANTEATER

ARMOUR is a covering, usually of metal, devised to protect life from the rigours of battle. There are two important types of armour for war purposes: (1) suits of copper, steel, or bronze plates once worn by human beings in battle, (2) steel or concrete used to protect vehicles or fixed points such as forts. As weapons grew better the armour grew heavier, until a knight, the only man who could afford to buy the best armour, had to be helped to get on to his charger. The way out of this difficulty was to have the armour carried by something else, i.e. to fight from behind movable armour. On land it took a long time to invent the means of carrying the armour, and, from Cromwell until the First World War, land battles were fought by unarmoured men, whose only protection was that of immovable trenches or concrete. At sea, however, where extra weight can more easily be carried, the sides and decks of warships were made of thick wood and iron, and later of hardened steel. The recent development of the petrol engine, which gives much power without being too heavy, has made it possible to carry heavy armour on land vehicles, e.g. the modern tank and armoured car.

ARNOLD, Matthew (1822-1888), was the son of the headmaster of

Rugby School whose impressive personality appears in Hughes's book, *Tom Brown's Schooldays*. Educated at Rugby and Oxford, Matthew Arnold became an inspector of schools, and a very thoughtful and influential educationist and writer on education.

Ultimately he spent ten years as Professor of Poetry at Oxford.

His early volumes of poems were failures, but in the score of years 1850-1870 he produced poems such as "Thyrsis," "The Scholar-Gipsy" and "Tristram and Iseult" which entitle him to his place among the great Victorians.

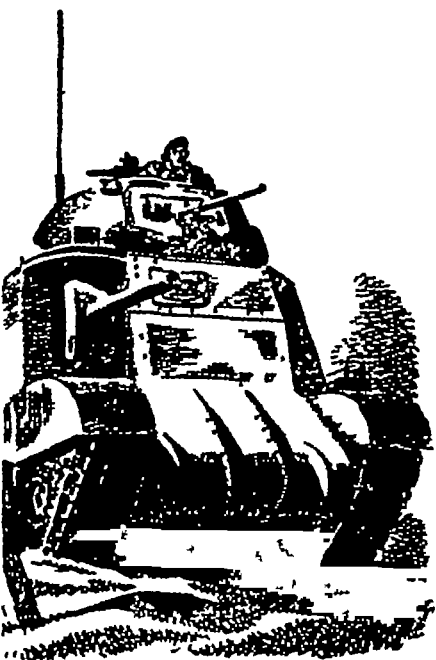
ARSENIC is a metal-like **ELEMENT** whose compounds are poisonous. They are used to kill weeds and vermin and to preserve anatomical specimens. Poison gases of the smoke type are in the main finely divided arsenical compounds.



Medieval knight in armour

ART is a term applied to a very wide range of activities. We talk of the art of DRESSMAKING, and of GARDENING, as well as of PAINTING, DRAWING, SCULPTURE and ARCHITECTURE. MUSIC, POETRY, the DRAMA, and the BALLET are also included in the arts, and rightly so. Most often, however, the term "art" is applied to the visual arts—the arts we enjoy through our eyes: pictures painted by an artist, statues made by a sculptor, and buildings designed by an architect.

First let us see what art really is. It is certainly more than a copy of the subject before the artist. For example, he has painted trees and hills and landscape many times and knows very well how to make them look like the things they are, but a camera could do that, the artist is striving to achieve more than that—he is trying to tell us something



and his modern counterpart

about them. It may be something which we have already felt but are unable to express ourselves, or it may be some new discovery he has made himself which he wants to convey to us. It is something deeper than just the appearance of things. It is the spirit he finds there and the way it affects *him*, it is Nature plus his own feelings—that is what he wants to express in his picture.

The artist may do this in several ways. He may draw a close imitation of the shapes that he sees before him, or he may only suggest the shapes and sizes and colours of things, or again he may not trouble about the actual appearance of individual things but rather concentrate on the whole sweep and rhythm of his composition, balancing one mass of colour against another and ignoring details, and so creating a pattern of colours.

The question of *how* the artist makes his picture does not matter very much, provided, of course, he has had enough skill to convey to us clearly and effectively what he wanted to express. But we who study the picture must also make our contribution. We must bring to his work an open mind. An artist of originality may adopt new standards and methods not always easily understood by his own age. We must be willing to be shown something through another person's imagination. The picture which at first sight seems strange may be capable of awakening a new understanding in us.

Dutch art includes all the art of the Netherlands—the Flemish as well as the Dutch. As in many other countries, Dutch painting grew out of ILLUMINATION. It is quite different from Italian art, being full of colour and detail from the beginning. Hubert and Jan van Eyck were the first and perhaps the

greatest of this school. They were the first artists to make full use of painting in oils. They lived in the 14th and 15th centuries, and are best known by their great altar piece called "The Adoration of The Lamb." It was two centuries before another master painter arose here, this was Rubens, an exuberant artist, who painted huge canvases, sacred as well as secular. One of his greatest works is "The Assumption." Van Dyck, who painted a great deal in England, was another



Van Dyck, Flemish artist

Flemish master. The Flemish painters were interested in sacred subjects, but the Dutch painters were unlike the Flemings. Being Protestants, they were not specially interested in religious pictures for churches, but painted the everyday things around them: landscapes, interiors of houses, portraits and groups of people. In Rembrandt, Holland produced one of the greatest painters of Europe. He painted the famous "Night Watch," and many portraits. Other Dutch masters were Frans Hals, Vermeer (who painted lovely blues and yellows), De Hooch, Jan Steen and, amongst moderns, Van Gogh, harsh but

vital, a genius of post-IMPRESSIONISM. See also LANDSCAPE PAINTING.

English art. The early art of England was almost entirely the art of illuminating manuscripts (see ILLUMINATION), and it was not until the 18th century that real native English artists began to appear. Before that time foreign artists had been employed to paint the portraits of famous people. Hans Holbein, a German artist, spent a long time at the court of Henry VIII, and painted the people there. Van Dyck, from Flanders, was court painter to Charles I, and he was followed by Sir Peter Lely, a Dutchman, who painted at Charles II's court.

The first important native English painter was William Hogarth, who began painting his satiric pictures of high society life in the 18th century. English art took mainly two forms, PORTRAITURE and LANDSCAPE PAINTING, and soon, fine painters appeared. Reynolds, who founded the Royal Academy in 1768 and was its first president, Gainsborough, Lawrence, Romney, and the Scot, Raeburn, were the principal portrait painters. In landscape, Richard Wilson, Constable and Turner were the giants, along with the great WATER-COLOUR painters John Crome, John Cotman and David Cox.

An eccentric genius was the poet and mystic William BLAKE (1757-1827) who painted what he saw in his "visions." He illustrated the Book of Job, and many of his own poems.

About the middle of the 19th century a group of artists calling themselves the Pre-Raphaelite Brotherhood broke away from the accepted style, and went back for their inspiration to the Italian painters before Raphael. "Back to nature" was their motto, and they drew things as they appeared in



Reynolds of the Royal Academy

every detail and colour, "selecting and scorning nothing" You may remember some of their works Millais's "The Blind Girl" and "Autumn Leaves," Holman Hunt's "Light of the World," and D G Rossetti's "Dante's Dream" These were the principal members of the group, but the movement did not last long

Another great innovator, who was to influence both European and American art, was J M Whistler (1834-1903) Unlike the Pre-Raphaelites, he simplified forms, ignoring details, and painting what he called "symphonies" of tones and colours His "Battersea Bridge" is typical of his art Following him come the artists of our time, among them the great portrait and landscape painters—Sargent, Oren, Augustus John, Sickert, Steer, D Y Cameron, Paul Nash and Duncan Grant See PAINTING, BAROQUE

French art It was not until the end of the 17th century that France began to produce art of a truly national character Up till that time French art was very much under the influence of Italian art Even Poussin and Claude Lorraine, two of the earliest French painters, spent so

long in Italy that their landscapes looked like those of Italian painters

Watteau (1684-1726) was the first truly French painter He painted the gay, lively life of his time One of the 18th century painters stands out from the rest, this was Chardin (1699-1779) who painted the things that belong to all time—the ordinary everyday things like jars, bottles, loaves of bread, fruit, books, woven materials, which, depicted in art, are called "still life"

A century later Delacroix, a follower of the Dutch artist Rubens, painted his great battle pieces, and led on to the poetical and landscape painters—Millet, who painted "The Angelus," and Corot, with his fine soft greys and greens, e g "The Bent Tree" A development from these were the late 19th-century IMPRESSIONISTS, among whom were Monet, Manet, Renoir and Degas

Since the 18th century Paris has been the centre of European art

Italian art The Italians have always been looked upon as the founders of European art It began with Giotto, in the 13th century, who painted in a straightforward natural way much as a gifted child does He started a revolution in



Degas, French impressionist

breaking away from the stiff formal art which had been going on for centuries before This was the beginning of the RENAISSANCE in art He painted the simple stories of the Bible as preached by a great friar of his time, St FRANCIS of Assisi, and used as his figures the ordinary people around him, e.g his "St Francis and the Birds" He was



Raphael, Italian painter

followed much later, after painters had learnt anatomy and how to draw, by Botticelli, whose "Coming of Spring" is inspired by an ancient myth

In the 16th century two outstanding geniuses appeared Leonardo da Vinci and Michelangelo, who was a great sculptor as well as a painter Leonardo is best known by his portrait of the "Mona Lisa," and his "Last Supper," and Michelangelo for his painting on the ceiling of the Sistine Chapel in Rome See BAROQUE

All those artists lived in Florence, but about the same time there were other artists painting in Venice They were great colourists, and

painted portraits and large religious pictures as well as themes from ancient story Giovanni Bellini, Giorgione, Titian and Tintoretto were amongst the greatest

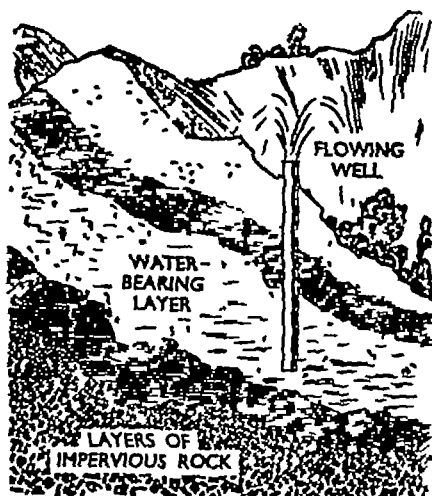
Farther south, in Umbria, during this fruitful century of art, one of the best loved painters in Italy was painting beautiful Madonnas This was Raphael, who painted the famous "Sistine Madonna" After these giants of art died, painting gradually declined in Italy See also PAINTING

Spanish art Until the 16th century there are no famous names in Spanish art But then came three famous artists who painted religious and classical subjects' and also the royal family and lords and ladies of the day The first was El Greco, a man from Crete, who after studying in Venice established himself in Spain in 1580 He was soon rivalled by the Spanish Velasquez (1599-1660), painter to the king, and then in the next century came Goya (1746-1826), a satiric genius, who revived Spanish art, which had declined since Velasquez's day

ARTEMIS is the Greek name for DIANA

ARTESIAN WELL. Rocks originally laid down by water may be either porous like chalk or sand, or impervious Owing to earth movements and the subsequent weathering away of the tops of hills, conditions like those in the illustration may be produced, where a saucer-shaped layer of chalk lies between impervious layers of rock, with its upper edge exposed to the rain Here the rain soaks in and saturates the whole layer of chalk, and if a hole is bored down to the chalk lower in the valley, then water will rise in it, perhaps even above the surface of the ground

ART GALLERY gets its name from the long galleries in Eliza-



How an artesian well is made

bethan houses which were used for hanging portraits and displaying art treasures. Today it is a museum of fine art in which the important works of art belonging to a town or nation are housed. Most countries have their national art galleries usually in the capital cities. In London, there are the National Gallery and the Tate Gallery; in Paris, the French national gallery called the Louvre, and also the Luxembourg; in Amsterdam, the Rijks Museum; in Madrid, the Prado; in Berlin, the Kaiser Friedrich Museum; in Florence, the Uffizi; in Edinburgh, the Scottish National Gallery.

ARTHROPOD means an animal with jointed legs. Arthropods are a group of backboneless types including INSECTS, SPIDERS, SCORPIONS, CENTIPEDES, millipedes, and CRUSTACEANS. They all have an external skeleton of horny or limey material, jointed like armour to allow movement. Many have a METAMORPHOSIS and they often moult. They live in every part of the world, and contain more species than all other animals put together.

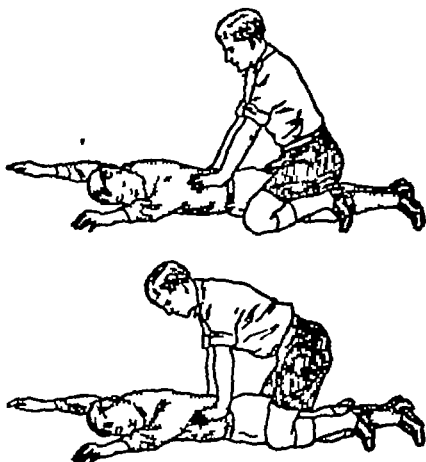
ARTHUR, a legendary king, was the centre of numerous stories in

the Middle Ages. With the aid of Merlin, the magician, he became King of Britain, and gathered round him the Knights of the Round Table—Launcelot, Gawain, Gareth, Percival, Tristram and best of all, Galahad. Of the legends of the knights, the most famous are the love story of Tristram and Iseult and the quest for the Holy Grail, the cup from which Jesus drank at the Last Supper. Galahad, as the purest of the knights, was the only one to find the Grail. After his last battle Arthur, wounded, was carried off to the enchanted land of Avalon. Legend said that he never died, but waits to return when his country most needs his help. The Round Table stories have been retold by many writers, including Sir Thomas Malory. See ENGLISH LITERATURE and TENNYSON.

The real Arthur is thought to have been a Romano-British leader who fought against the Saxon invaders and defeated them in twelve great battles.

ARTICLE See GRAMMAR

ARTIFICIAL RESPIRATION is the process of artificially reproducing the movements of the lungs, when their normal function has



Artificial respiration

stopped as the result of gas poisoning, apparent drowning, electric shock. The usual way of doing this is by Schafer's method—lay the person affected face downwards, kneel astride him, looking towards his head, and place your hands on the lower part of his back, with your arms straight. Gradually throw your weight on to your arms while counting "one, two", at "three" release the pressure, and after a pause of two seconds repeat the pressure. Carry on until the person commences to breathe again.

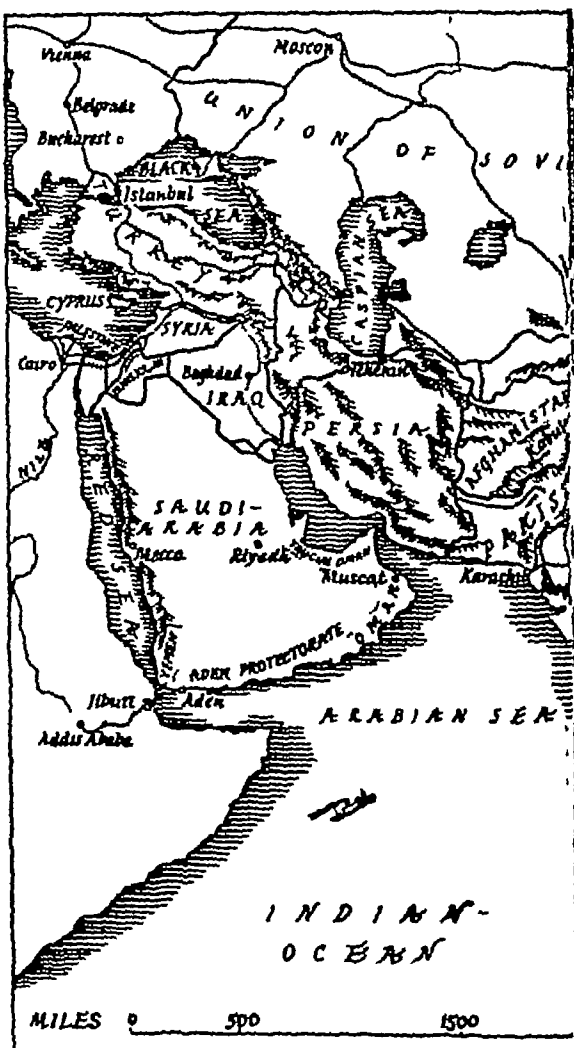
ARTIFICIAL SILK is made from **CELLULOSE** or its compounds, dissolved to make a thick solution, and then squirted through fine jets into another solution, which by chemical action produces a hard thread, light, thin and strong, comparable with natural silk. The various names rayon, Cclanese, viscose, acetate silk and others, are given to the products produced in this way from modified cellulose and cellulose nitrate, xanthate and acetate.

Thus purely chemical discoveries and processes developed in the present century now form the basis of a great new clothing industry.

ASBESTOS is a rock which when crushed gives a fibrous substance which can be woven into a fire-resisting material.

ASCENSION means a going up. The Ascension of Christ was the occasion of His final disappearance from the sight of His followers.

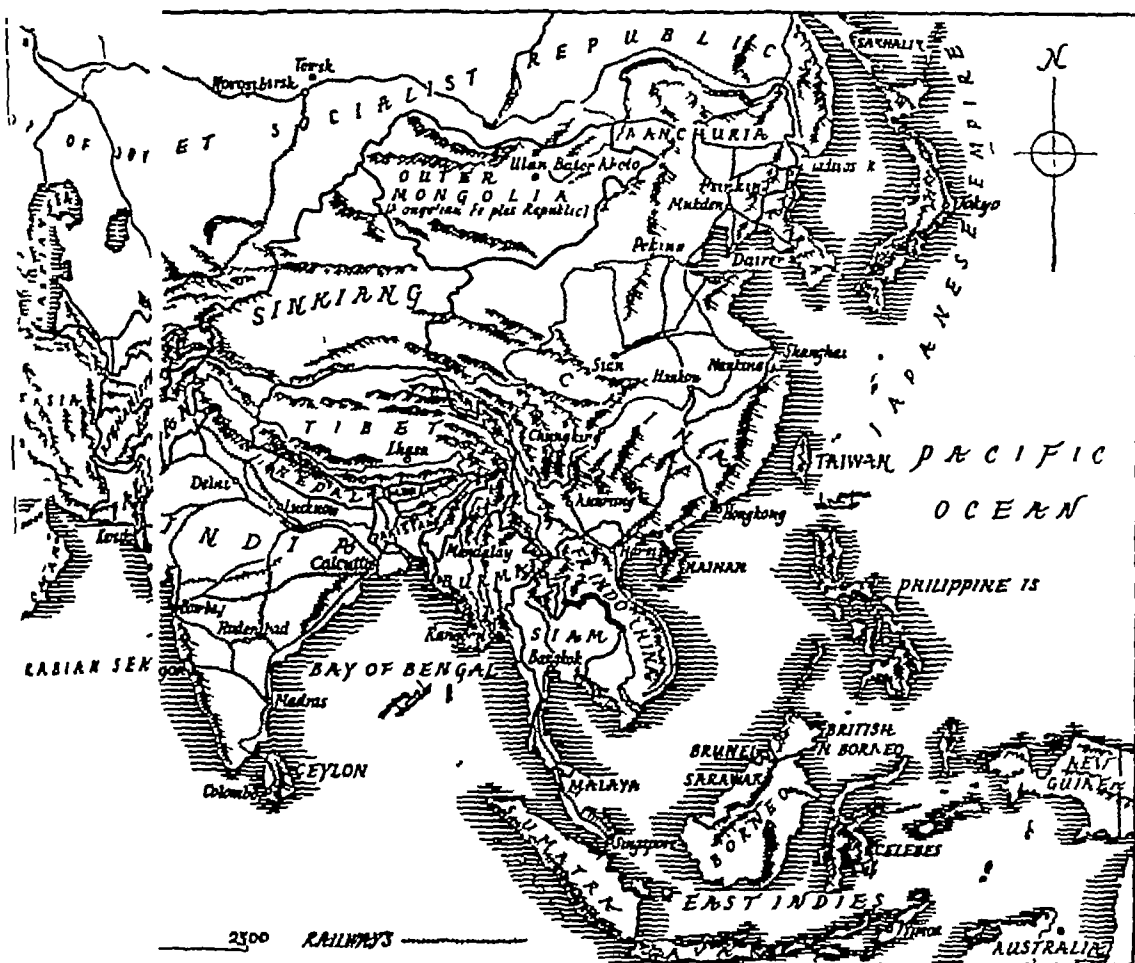
ASIA is the largest of the **CONTINENTS**. The central area consists of vast **PLATEAUX** and mountain systems, with many snowfields and glaciers. The great Siberian lowland of Russia and the arctic regions lie to the north, and the plateaus of Arabia and the Deccan of India to the south. The most densely populated areas are the fertile alluvial lowlands of China and India. Many



Asia is the largest of the

regions of high mountains, waterless deserts, marshes and forests are very sparsely populated. See **AFGHANISTAN**, **BHUTAN**, **BURMA**, **CHINA**, **CEYLON**, **EAST INDIES**, **INDIA**, **PAKISTAN**, **NEAR EAST**, **INDO-CHINA**, **JAPAN**, **MALAYA**, **PERSIA**, **SIAM**, **NEPAL**, **TIBET**, **TURKEY**, **UNION OF SOVIET SOCIALIST REPUBLICS**.

ASPIRIN is acetyl-salicylic acid, a white **ORGANIC** powder which alone, or as a compound, mixed with a little starch or sodium bicarbonate, is widely sold under a multitude of competitive trade names for the relief of pain of nervous origin.



contents this map shows its countries and chief mountain ranges

ASSYRIANS See **ANCIENT WORLD**

ASTROLOGY is the study of the stars in relation to human affairs, and their effects upon our lives. There is no experimental proof of any connexion between the stars and human destinies, and the contentions of modern astrologers affect only credulous and superstitious people. None the less, the old astrologers, by noting the behaviour of the stars and their motions through the heavens, did a great practical service for the later astronomers. See **ASTRONOMY**

ASTRONOMY is the study of the heavenly bodies, their movements, sizes and composition, and is of considerable practical value in navigation.

ATHEIST, one who argues that God exists only in man's imagination and that all forms of belief in the supernatural or divine are forms of superstition.

ATHLETICS is the broad name for competitive outdoor sports of an individual nature, as opposed to team games. Track athletics include running, walking, and hurdling, while field athletics comprise high

and -long jumping, pole-vaulting, weight-putting, throwing the hammer, javelin, and discus Such sports form a large proportion of the events at the OLYMPIC GAMES

ATLANTIC CHARTER, drawn up by Winston CHURCHILL, the British Premier, and President Franklin ROOSEVELT of the U S A , when they met on a ship in the Atlantic in 1941 during the Second World War They declared that

(1) Their countries desired no increase of power or territory

(2) They desired no territorial changes except by the consent of the peoples concerned

(3) All peoples should be free to choose the form of government under which they will live, and sovereign rights and self-government taken away by force should be restored

(4) All nations should be allowed access on equal terms to the trade and to raw materials necessary for their welfare

(5) They would try to establish such friendship between the nations as would improve the standards of living and strengthen social security

(6) They wished to see all men enjoying freedom from fear and want

(7) All men should be free to travel over the oceans without interference

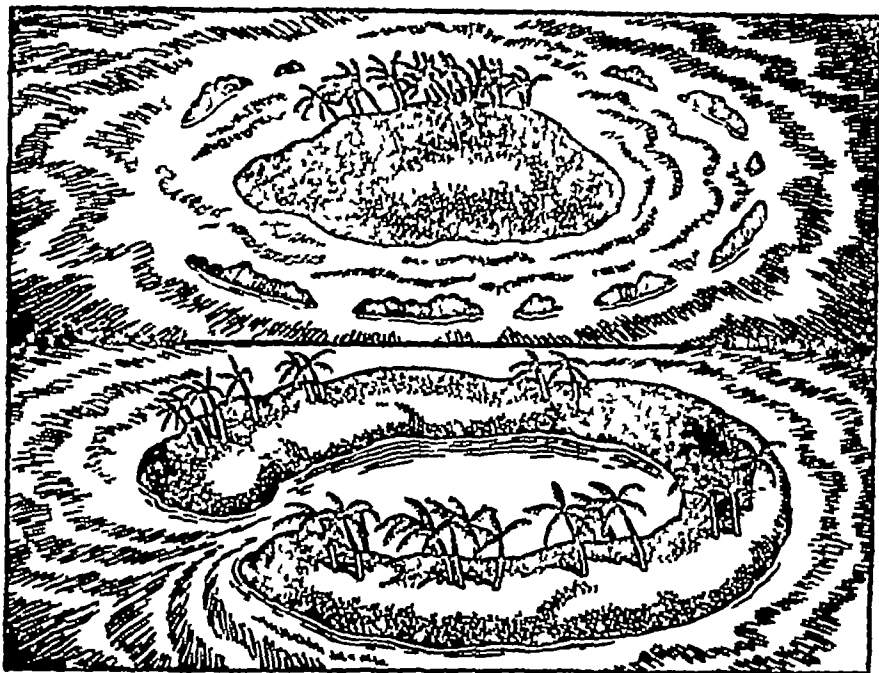
(8) They wished to see such a peace established as would free the nations from the necessity of spending vast sums of money on armaments

ATLANTIC OCEAN, divides America from Europe and Africa, and the Arctic Ocean from the Antarctic Iceland and the Azores, St Helena, and Tristan da Cunha, are exposed parts of submarine ridges running from north to south of the ocean

ATLAS in CLASSICAL MYTHOLOGY is the Titan who held the Heavens and the Earth apart It is said that PERSEUS showed him the GORGON'S head and that he was thus turned into the mountain in north-west Africa which bears his name

ATMOSPHERE, the layer of gases which surrounds the earth It is composed of the following nitrogen 78 per cent, oxygen 21 per cent, argon 0.9 per cent, carbon dioxide 0.03 per cent, hydrogen 0.01 per cent, neon 0.002 per cent, helium 0.0005 per cent, krypton 0.0001 per cent, ozone 0.0001 per cent, xenon 0.00001 per cent, these are the proportions in dry air—ordinary air has dust and moisture, too The pressure of this mixture of gases at sea level is 14.7 lb per square inch Our bodies are so accustomed to this pressure that we are quite unaware of it, and if it were removed we should burst This pressure of the air at the earth's surface is measured by means of the BAROMETER, and it varies according to the state of the air, since warm air is lighter than cold air, and damp air lighter than dry A slowly rising barometer often indicates fine weather, and a falling barometer unsettled weather Winds blow from high pressure to low pressure regions Air pressure decreases with the altitude, beginning at the rate of about 1 inch of mercury for every 1,000 feet that we rise, and the pressure is negligible at 70 to 80 miles above the earth's surface

ATOLL, a ring-shaped reef of CORAL enclosing a lagoon which has an opening to the sea on the leeward side, where the coral does not grow so well The reef is formed by the coral sea-animal These tiny organisms group themselves round an island in the sea, and in time when the island is submerged the coral reef remains, constantly growing on



An atoll is a coral reef which has grown around an island since submerged

its outward side. The largest atolls are inhabited, the people living mainly on coco-nuts and fish.

ATOM, the smallest part of an **ELEMENT** which can be said to retain the characteristics of that element. Normally atoms exist not singly but in groups, called **MOLECULES**. When, however, an element enters into a chemical reaction, it appears to do so in an atomic form, i.e. the molecules break up. Even the atom, however, is not an indivisible unit. It appears to consist of a nucleus carrying a charge of positive electricity surrounded by electrons carrying a negative charge.

It is now possible to remove some of the charges in an atom and thus turn it into an atom of another substance. At present this can only be done on a very small scale. See **ATOM BOMB** and **ATOMIC ENERGY**.

ATOM BOMB, a bomb in which the intense heat generated by the sudden release of **ATOMIC ENERGY**

from the break-up of the **ATOM** is allowed to heat up the surrounding substances, including the air, thus causing a sudden and violent expansion, known as blast. Harmful radioactive rays are also given off. In the first atomic bombs, a special kind of **URANIUM** was used.

ATOMIC ENERGY. An **ATOM** is a pattern of electrical charges which is more or less stable. In a similar way we might consider a tightly-wound clock spring as being stable. If, however, we release the catch which holds the spring we know that it will suddenly unwind and give out a great deal of energy. Well now, it has been found possible to cause some of the more unstable atoms, like **URANIUM**, to break up their normal pattern and split up. In so doing they give off a great deal of energy both as heat and radioactive rays. See **ATOM BOMB**.

This energy can be applied to useful ends. The most interesting

point about atomic energy is the enormous amount of it which can be obtained from only a few ounces of material, equal to the energy to be obtained by burning many tons of coal

AUGUSTINE OF CANTERBURY, St., a great Christian missionary Gregory the Great saw a crowd of flaxen-haired English slaves in the market place, and, when he had become Pope, he sent Augustine as a missionary to England Augustine landed in A.D. 597 Ethelbert, the King of Kent, invited him to live at Canterbury Queen Bertha was already a Christian, and soon the king was baptized by Augustine, who became the first Archbishop of Canterbury See **ANGLO-SAXONS**

AUGUSTUS. See **ROME**

AURORA BOREALIS (Northern Lights), beams or patches of light, often brightly coloured, seen in the sky in northern latitudes, generally at night Similar lights, the Aurora Australis, are seen in southern latitudes

AUSTEN, Jane (1775-1817), was born at Steventon, Hants, one of the children of the rector Her life, devoid of startling incidents, was spent in country parishes and in Bath, then still a fashionable health and holiday resort

She began writing when she was twenty-one with *Pride and Prejudice* It was sent to a publisher, who refused to consider it, and its revised form did not appear until 1813 Her first published book was *Sense and Sensibility*, which was an immediate success *Northanger Abbey*, her very next book, was accepted by a publisher who did not issue it, some years later she recovered the manuscript with difficulty, but it, as well as *Persuasion*, did not appear until she was dead In the meantime there had been



Jane Austen, English novelist

published *Mansfield Park* and *Emma*

The material for her novels she found in the kind of people amongst whom she lived—country gentlefolk of the middle class She views them detachedly, ironically and good-humouredly Her letters show how closely she observed people and how seriously she took her work, refusing to be drawn into any writing that she felt unsuited to her range and abilities

AUSTRALIA is an island continent lying entirely in the southern hemisphere The great western **PLATEAU** is separated from the eastern highlands by the lowlands of the Lake Eyre depression and the Murray-Darling basin, and by the coastal plains of the Gulf of Carpentaria The Great Barrier Reef follows the north-east coast for a thousand miles Many of the rivers in the west and centre are dry for part of the year Rainfall is uncertain in many areas and farmers depend for irrigation on reservoirs and artesian wells

Forests and woodland occur on the wetter margins, farther inland

are the grasslands, which support the cattle and sheep for which Australia is famous. Much of the original bush country has been cleared for agriculture. Scrub and desert cover the remaining areas, where population is very small except where the presence of gold and other metals has attracted settlement, as at Kalgoorlie in Western Australia.

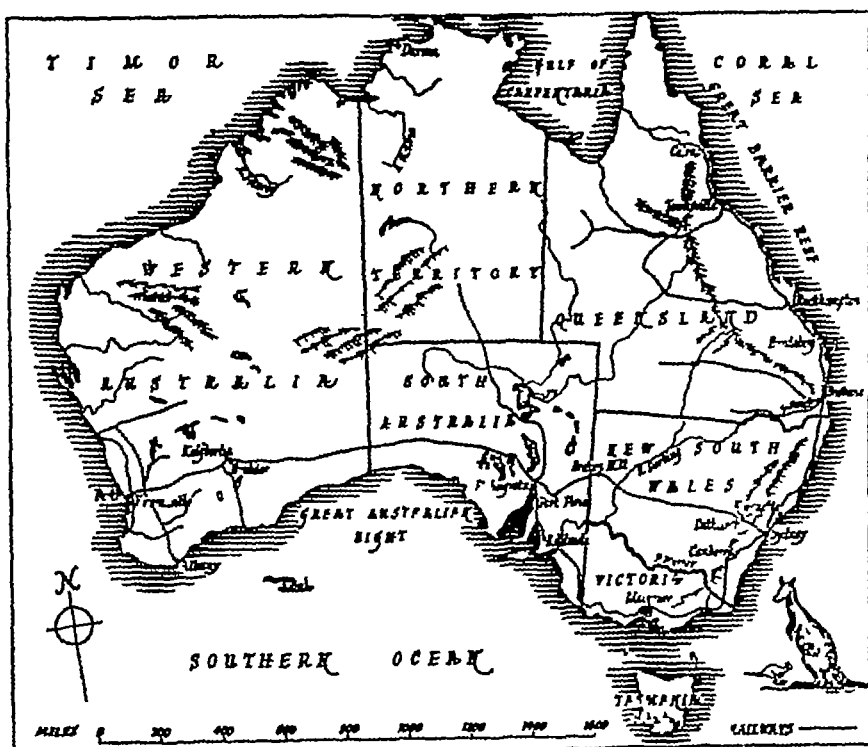
The chief exports are wool, beef, mutton, wheat, butter, wine and fruits from the mainland, and apples from Tasmania. Most of the trade is with Great Britain, and most of the people are descended from British settlers. The black aborigines are gradually dying out.

History The word "Australia" means "South Land." This continent was known to the Dutch as early as 1598. Dutch sailors visited

the western coasts, which they named New Holland. The first Englishman to reach Australia was Captain Dampier in 1688, and he agreed with the Dutch in describing it as a barren land.

But in 1770, Captain Cook arrived on the east coast, and found it very fertile. He landed on the shores of an inlet, which he named Botany Bay on account of the great variety of flowers and plants, and he took possession of the land in the name of King George III, naming it New South Wales.

Britain first used her new territory as a convict settlement—in those days men and women were sent across the seas for even small offences. In 1788 six ships, carrying 750 male and female prisoners, stores, tools, cattle and seeds, arrived under the command of



Australia, showing the states, rivers and mountains

Captain Phillip and settled near the present town of Sydney Five years later the first free colonists arrived, and soon with other colonists new settlements were made along the coast of New South Wales and also in Tasmania In 1813, a way was found through the Blue Mountains to the fertile inland plains, and explorers followed the rivers down to the south coast

In 1829, the Swan River Colony (Western Australia) was founded Increasing settlement led to the political separation from New South Wales of the colonies of South Australia (1836), Victoria (1851) and Queensland (1859)

A steady stream of colonists continued to arrive, sheep farming and corn growing developed, and a "gold rush" in Victoria and New South Wales attracted the more adventurous In 1840 the transportation of convicts to eastern Australia ceased, but Western Australia continued to be a convict settlement until 1868 Between 1850 and 1860, responsible government as in Britain was granted to all the States (as the colonies were called), except Western Australia which did not receive it until 1890.

Each State had its own parliament But in due course it was felt there should be a FEDERAL (or United) Parliament to deal with matters affecting all the States, and in 1891 a Federal Constitution was planned but was not accepted by the States until 1898. In 1900, by Act of the Imperial Parliament, the "Commonwealth of Australia" was created In 1908, the site for a new federal capital was chosen at Canberra, 200 miles by rail from Sydney. The first meeting of the Federal Parliament at Canberra took place in 1927, when the opening ceremony was performed by the Duke of York (now George VI)

By the Statute of Westminster (1931) Australia received the rights of a free nation "united by a common allegiance to the Crown and associated with the other dominions as members of the British Commonwealth of Nations "

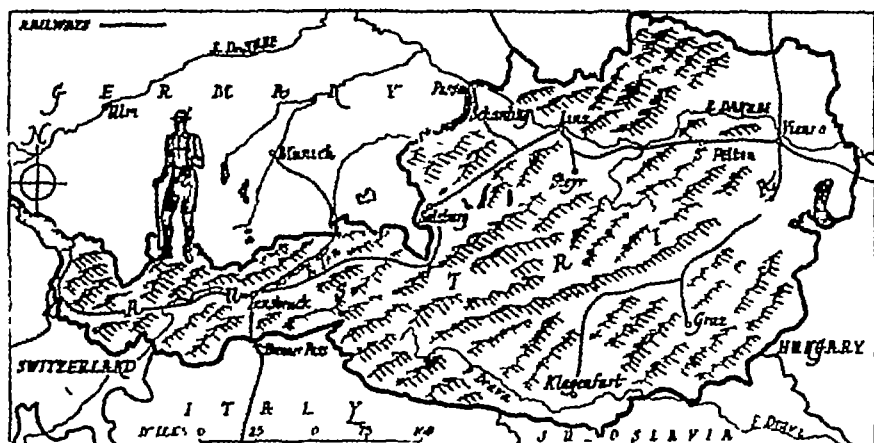
In the two World Wars, Australia fought side by side with Britain, giving freely of men and material in defence of freedom In the Second World War she was for a time in grave danger of invasion by Japan

AUSTRIA is an independent German-speaking republic of central Europe It is mainly mountainous, and more than a quarter of the people live in Vienna, the capital, a great scientific and artistic centre In the mountain districts, such as the Tyrol, the chief occupations are forestry, water-power development, dairying, and catering for tourists Other industries are small Wheat, potatoes, and sugar beet are grown in the Danube valley and round Vienna The Brenner Pass leads to Italy

History Until the First World War (1914-1918), Austria was part of the Habsburg Austro-Hungarian Empire, which consisted of Austria and Hungary—two separate kingdoms under one emperor—and the provinces of Bohemia, Moravia and Silesia At the close of that war, Austria and Hungary became independent republics, and other provinces became the new republic of Czechoslovakia

In 1934, between the two World Wars, Austrian Nazis tried to seize power, and Dollfuss, the Chancellor, was killed Four years later, in March, 1938, German Nazis marched into Austria, and the "Anschluss" or "Union" with Germany took place

Towards the end of the Second World War, Austria was invaded



Austria is largely covered with mountains, part of the Alps

by the Russians, who captured Vienna. Great Britain, the United States and the Soviet Union pledged themselves to restore the independence of Austria.

AUTO-GYRO. See **HELICOPTER**.
AUTOVAC, a device whereby low pressure in the induction pipe of an internal combustion **ENGINE** is used to lift petrol from the main tank to a small tank near the engine.

AVERAGE An average of several like quantities can be found by adding the quantities together and dividing their total by the number of quantities involved. Thus the average of 8, 11, 7, 8, 7, 6, 10, 9 is $8\frac{1}{2}$.

Now take a group of people in the street, and imagine that we could estimate their heights at a glance. We might see three tall Guardsmen, height 6 feet 2 inches, 6 feet $1\frac{1}{2}$ inches and 6 feet 1 inch, then a group of schoolboys, 5 feet 2 inches, 5 feet 1 inch, 4 feet $9\frac{1}{2}$ inches, and 4 feet 9 inches, then three mothers with their babies, the mothers being 5 feet 4 inches, 5 feet 2 inches and 5 feet 2 inches, and their babies, 2 feet, 1 foot 11 inches and 1 foot 10 inches.

Add up these varying heights, and divide by the number of per-

sons i.e. 59 feet 7 inches divided by 13 = 4 feet 7 inches—this is called the arithmetic mean average.

But this average might not be very helpful because of the wide divergence between the height of the soldiers and that of the babies. If there had been one more Guardsman and one less baby, the answer would have been very different.

Another sort of average is called the *mode*, which is the number or quantity (in this case the height) which appears most often.

Yet another average is called the *median*. This is the middle term when the items are arranged in order of magnitude. If the items are an odd number, it is easy to spot the median and if they are an even number, the median is the mean of the two terms in the middle.

Averages are much used in the science of **STATISTICS**.

AYRE, a song which developed from the **MADRIGAL**. It had one definite melody, with other voices singing the accompaniment, which could be played on a lute.

AZTECS are the best known of the tribes that inhabited Mexico before it was conquered by the Spaniards under Cortes in 1521.

BABOON. See **MONKEY**

BABYLON. See **ANCIENI WORLD**

BACCHUS in **CLASSICAL MYTH-
OLOGY** is the god of wine, mirth,
and revelry

BACH. The Bach family com-
prises several generations of music-
ians The greatest of these was
Johann Sebastian Bach (born at
Eisenach, 1685, and died at Leipzig,
1750) Every branch of music,
except opera, is indebted to him
He started his career at Arnstadt as
a church organist, and then went to
Weimar and wrote there his great
organ **PRELUDES** and **FUGUES** Later,
at Cothen, he was the court
musician to the Prince, with an
orchestra at his command There
he wrote his **CHAMBER MUSIC**, con-
certos, sonatas for unaccompanied
violin and violoncello, harpsichord
music, and the first part of his great
collection of preludes and fugues
for the clavichord—the "Well-
tempered Clavier" The last part
of his life was spent at Leipzig as
organist of St Thomas's Church
There he wrote the wonderful series
of works for the church service—



J S Bach, German musician

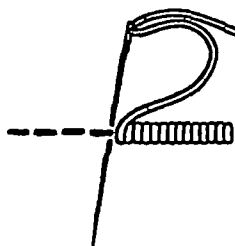
church **CANTATAS**, settings of the
story of the Passion according to
the different Evangelists, and the
superb "Mass in B Minor" His
sons, Wilhelm Friedemann, Carl
Philipp Emanuel, and Johann
Christian, were all fine musicians
and each made contributions of
value to the development of music

BACK STITCH is used because
of its strength to join two pieces of
material, and
for sewing on
tapes and **BUT-
TIONS** It is also
used as an **EM-
BROIDERY out-
line stitch**



Back stitch

Work from right to left First make a
RUNNING STITCH, then insert the
needle again at
the beginning
of this stitch
and bring it
out at a dis-
tance of twice
the length of
the stitch



Overcast version

Overcast
back stitch is a
decorative form of this stitch

BACON, Francis (1561-1626), a
nobleman's son, was a lawyer who
entered parliament He was a gifted
man, devoted to things of the mind
The Earl of Essex became his friend,
and worked for Bacon's advance-
ment, but by a strange twist of fate,
Bacon was responsible for the in-
quiry into Essex's rebellion in 1601,
and the resulting death penalty In
1618 he became Lord Chancellor,
but three years later was charged in
the House of Lords with taking
bribes, and dismissed from office
The rest of his life he gave to
literary and scientific work He died

from a cold caught while experimenting with the effect of snow on the preserving of food

His scientific and philosophic writing was designed to review the whole state of knowledge, and helped to develop a more scientific way of thinking which in turn led men to a better understanding of the natural world. Some people contend that he was the author of the plays attributed to Shakespeare, but this is highly improbable in view of the characteristics of Bacon's own writings in which a very different type of mind from Shakespeare's is at work. Bacon's writings include *The Advancement of Learning*, *Essays* and *The New Atlantis*.

BACTERIA (germs or microbes) are minute living organisms, appearing under a microscope as groups of tiny rods, spheres or spirals. Ten of some, five hundred of others, would be needed to reach across one millimetre. Some are essential to man, making soil fertile, or are necessary in bread-baking, cheese-making, etc. Certain bacteria are **PARASITES**,

multiplying rapidly in the bodies of animals or plants, and causing human diseases such as typhoid and diphtheria, cholera and influenza.



Magnified shapes of typical bacteria

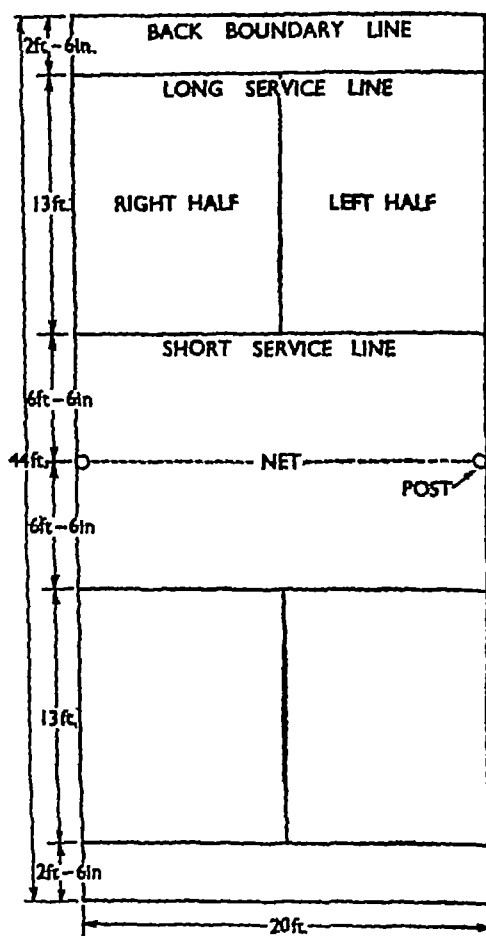
BADGER, a sturdily built **FLESH-EATING MAMMAL** with greyish fur and a black and white striped head. Badgers live in the earth, deeply burrowing in woodland, and come out at night to hunt for young rabbits, grubs, bulbs, etc.

BADMINTON, which resembles tennis, is played with racquets and shuttlecocks and generally on covered courts. The full-sized double court is 44 feet long and 20 feet wide. Games may be either doubles or singles, i.e. two players on each side or one only. For the singles the court is reduced to a width of 17 feet, the long service lines are dispensed with, and the lines dividing the half courts are continued to the back boundary lines which become the long service lines. A net across the middle of the



*Francis Bacon, Lord Verulam,
writer, statesman, scientist*

court is 2 feet 6 inches deep and is supported by a post at each end. The net should be 5 feet from the ground at the centre and 5 feet 1 inch at each post. The racquet of five to six ounces is strung with fine



Badminton doubles court

gut, and the light shuttlecock has from fourteen to sixteen feathers $2\frac{1}{2}$ to $2\frac{3}{4}$ inches long.

The server stands in his right half court and serves, that is, he hits the shuttle over the net with his racquet towards the player who stands in the diagonally opposite right half court. His opponent has then to return the shuttle by hitting it with his racquet before it touches the ground. It is then hit backwards and forwards over the net until it

touches the ground, when an ace is scored against the side which fails to return it.

A game consists of fifteen aces and occasionally of twenty-one, except in ladies' singles when it is eleven aces. A rubber is the best of three games although matches are decided by one game when twenty-one aces are played.

A fault is made (1) if on serving, the shuttle when struck is higher than the server's waist; (2) if the shuttle does not fall into the half court diagonally opposite to the one in which the server stands, (3) if the shuttle falls short of the service line, (4) if the shuttle falls outside the boundary lines, (5) if the shuttle touches anything except the racquet or the top of the net; (6) if the shuttle, after being served, is again struck before it crosses the net or if it is struck both by a player and his partner, (7) if the striker touches the net with his racquet or in any other way, or serves otherwise than with both feet in his own court.

When the server's side makes a fault he loses his serve to the player served to, but no score is made. When the non-serving side makes a fault, an ace is counted to the serving side, and the two players of each side change half courts and the server serves from the adjacent half court. The server serves alternately from each half court to the half court diagonally opposite, this change taking place only each time an ace is scored.

The players change ends after each game, in any third game they change over again when the side which is winning reaches eight aces (or six in a ladies' singles).

BAGPIPE, a musical instrument consisting of a reed set in vibration by a supply of wind kept in a bellows operated by the player's arm. The player keeps the bellows full



Countries of the Balkan Peninsula and their chief features See p 56

by blowing into it. The reed is contained in the "chanter," and the pitch is varied by holes which are covered by the player's fingers. The column of air which is set in vibration by the reed is thus made longer or shorter. When all the holes are closed, the column of air fills the whole tube, but, when any hole is opened, the air escapes through it and the air column then is merely the length from the reed to the opening. Thus different notes are produced.

The best known bagpipe is the "Highland" or "great" pipe of Scotland. The player fills the bag by means of a blow-pipe, the wind passes from the bag to the chanter, where the tune is made, and there

are, in addition, three large drone-pipes which supply an unchanging bass. Its battle marches have inspired countless thousands of Scottish soldiers, its strathspeys and reels have set going the feet of innumerable dancers, and its laments have expressed the sorrows of the Highlands. See picture on p 404.

BAHAMAS, a group of British CORAL islands north of the WEST INDIES proper. Sponges, tomatoes, pineapples and early vegetables are exported. Nassau, the capital, is a well-known tourist centre. See also map of CENTRAL AMERICA.

BAHRAIN ISLANDS, in the Persian Gulf, under British protection. The capital is Manamah.

BAIRD, John L (1888-1946), was the British scientist who invented TELEVISION and spent much of his life improving its technical processes

BALANCE OF POWER, one of the oldest aims in international affairs in relations between the nations of Europe It tried to prevent any one state or group of states becoming too powerful and able to dictate to other states If one state seemed to be dangerously strong, other states would form an alliance, so that their united strength might resist possible aggression

In our own days, after the terrible Second World War, it is hoped to solve difficulties between nations by means of the UNITED NATIONS ORGANIZATION, known as U N O

BALANCE SHEET, a statement of accounts prepared by every business, after the ending of the financial year It is from this balance sheet that the owners, whether they are partners in a private firm, or shareholders in a public company, are able to obtain definite information on (1) the results of the year's trading, (2) the financial position of the business, (3) the present progress of the company as compared with the past

What the balance sheet should contain is laid down by law It is the general practice to place the liabilities on the left hand or debit side, and the assets on the right hand or credit side The balance sheet is part of the general financial statement that includes the profit and loss account of the business and sometimes also the trading account It is presented by the directors after having been checked by an auditor See also BOOK-KEEPING

BALKAN PENINSULA, a mainly mountainous region bounded by the Adriatic and Black Seas and the Mediterranean, and in the

north by the plains of Hungary and Rumania. Agriculture is carried on in the lowland areas It is divided into several states, formerly parts of the old Austro-Hungarian and Turkish Empires See ALBANIA, BULGARIA, GREECE, JUGOSLAVIA, RUMANIA and TURKEY and map on page 55.

BALLAD. See ENGLISH LITERATURE

BALLADE, a poem of three stanzas having the same line as a refrain at the end of each verse, and with a conclusion, called the Envoi, usually addressed to a prince

BALLANTYNE, Robert Michael (1825-1894), was the Victorian author of a number of readable novels for boys, including *The Coral Island*, *Martin Rattler*, and *The Young Fur Traders*, in which he used some of his own experience, gained with the Hudson's Bay Company

BALLET was originally a name used by the Elizabethan composers for a dance-like composition for voices which had a regular rhythm and in which each section was divided from the others by groups of fa la la's Nowadays the word has come to mean a stage spectacle in which dancing—the main element—is combined with music, scenery and costume There is usually a simple story but no speech or song The dancers *dance* the story, expressing their emotions by graceful movement to the accompaniment of the music The modern art of ballet owes much to the Russians Many composers have written music for ballets, such music as the *Sylvia* and *Coppelia* suites of Delibes and the *Nut-cracker* suite of TCHAIKOVSKY are well known to many who have never seen the ballets The sketches opposite show the vigour and daintiness of typical ballet scenes



BALLET DANCERS AT PRACTICE



EXERCISE AT THE BAR



FROM 'COMPANY AT THE MANOR'

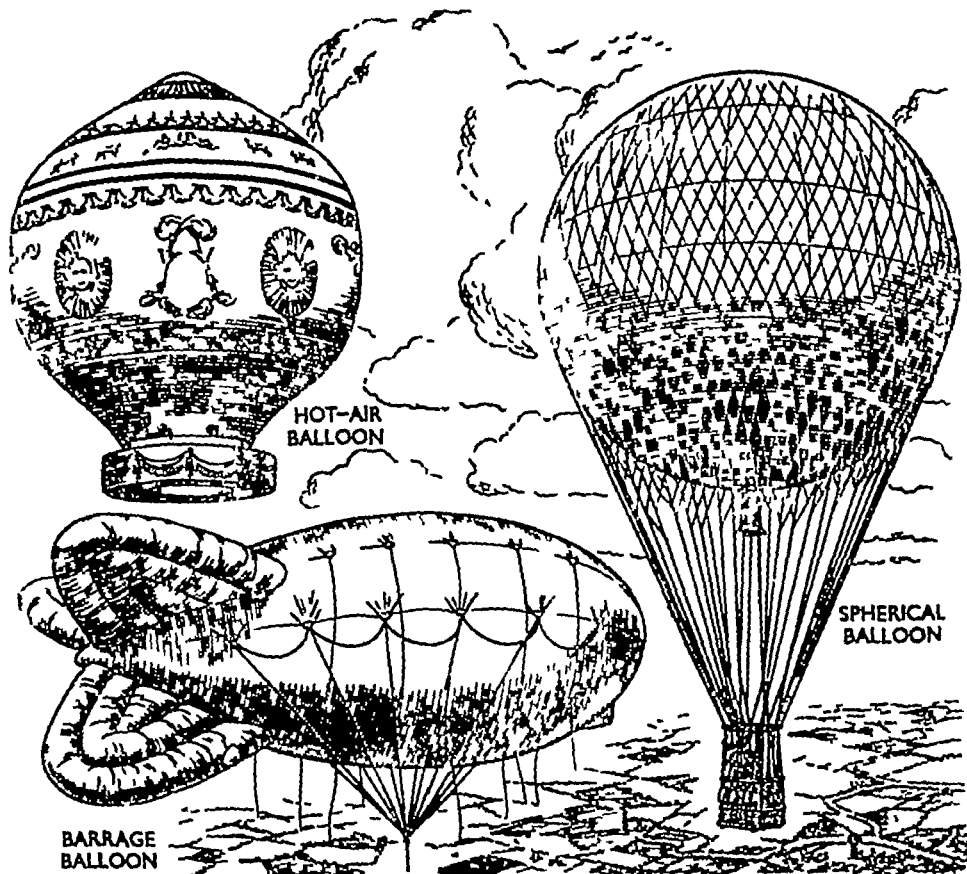


FROM "CARNIVAL"



FROM THE SWAN LAKE BALLET

The ballet, a form of art which tells a story by dancing to music



Eighteenth-century hot-air balloon and hydrogen-filled spherical balloon of a century later contrasted with the modern barrage balloon

BALLOON, a bag usually of silk inflated like a ball with a gas less dense than the atmosphere, and therefore able to lift a load. The first balloons were filled with hot air, which is less dense than cold air, but later hydrogen was used. Daring adventurers made long trips in balloons, but it was found impossible to control the direction in which the balloon went. Balloons are used in warfare for holding up cables over important targets against low-flying aeroplane attack. They are also useful for sending up scientific instruments which obtain information about temperature, wind, pressure, humidity and radiation at very great heights.

BALLOT. Voting by ballot, or secret voting, is the method used

in democratic countries for parliamentary or local government election (See **TOWN OR BOROUGH COUNCILS**). It was introduced into Britain by the Ballot Act of 1872.

BALTIC STATES, three republics, **ESTONIA**, **LATVIA** and **LITHUANIA**, on the shores of the Baltic Sea, which after a period of independence following the Russian Revolution of 1917, were in 1940 admitted as autonomous republics into the **UNION OF SOVIET SOCIALIST REPUBLICS**.

BALZAC, Honoré de (1799-1850), was a French novelist of the greatest all-round achievement. His works, taken as a whole (notable among which are *Eugène Grandet* and *Père Goriot*) give a profoundly realistic picture of the different classes and

types in French society, a picture which he himself dubbed "The Stage of Life"

BAND A *brass band* is a combination consisting of brass instruments—CORNETS, SAXHORNS, TROMBONES, TUBAS—and DRUMS Such bands are very popular among music amateurs, especially in the north of England, and festivals are frequently held to discover the best brass band

A *military band* is the band of a regiment, composed of brass instruments, including the CORNET and SAXHORN, WOODWIND, especially CLARINETS, PERCUSSION, and perhaps SAXOPHONES Any civilian band based on this combination is known as a military band

BANJO, a musical instrument of the guitar family having a sort of tambourine of parchment stretched beneath the strings to reflect and amplify the sound It has five or six strings, one being used to give the tune and the others to provide the "plinky-plonky" accompaniment of chords which is characteristic of all its music It is particularly associated with Negro and early jazz music See LUTE, GUITAR, MANDOLINE, and page 404

BANK, an institution with a two-fold function First it acts as a money box It keeps people's money safe and readily available It is thus a savings bank Secondly, it lends money to people who need it It is also therefore a money lender Any person can go to any bank and deposit money, that is, ask the bank to look after it He becomes a customer of the bank When he deposits his money at the bank, we say he opens a bank account

There are two types of bank account The first is a Current Account When a customer deposits money in the safe keeping of the bank, he can at any time claim the

repayment of the money, in part or in whole, by means of a written order to the bank signed by himself Such an order is called a CHEQUE Cheques can be made payable to the customer himself (he writes "Self" and signs his name), or to another person whom he names There are many advantages in paying by cheque first, you are saved the trouble of handing over cash, secondly, when the person to whom you have given the cheque presents it at the bank, he has to endorse it, that is, he has to write his name at the back of the cheque, and this endorsement can be made to serve as a receipt, thirdly, he does not draw out the actual money He can place the cheque to his own bank account Thus cheques make payments safe and easy and also economize the use of money

The second kind of account is a Deposit Account When the bank receives money on deposit, the understanding is that the customer can demand its return at the end of an agreed term of notice of withdrawal, a fortnight or month or a twelve-month On such deposit accounts, banks pay interest

So far, the bank has acted as a money box and a savings bank The bank also acts as a money lender The bank lends money to customers just as the bank receives deposits from customers Of course the bank manager will ask the customer who asks for a bank loan how long he needs it, how he expects to repay it and what security he can offer (The best security is the customer's honesty and known probity) On this bank loan, the bank will charge the borrower interest The bank need not hand over actual money It will credit the borrower with the amount borrowed, exactly as if he had deposited that amount The bank will give him a cheque

book and allow him to draw cheques up to the amount borrowed And when he pays by cheque nobody but the bank knows whether he has obtained the right to draw, that is, to sign cheques because he has deposited money with the bank or because he has borrowed money from the bank As long as the bank honours the cheque, that is, pays the amount stated to the person named, all is well

If a bank will not honour a cheque because the drawer has no money deposited with the bank and the bank will not lend him any, the cheque will be returned with the initials R D — "Refer to drawer"

When banks began, they were private businesses, but today they are large companies and by a process of amalgamation there have emerged the big five, Westminster, Barclays, Lloyds, the Midland, and the National Provincial

There is also the Post Office Savings Bank This bank does not lend money nor does it give its customers a cheque book In it people place their money for safety and on these deposits the Government pays interest Arrangements are made for the money to be easily withdrawn when needed

The Bank of England was also originally a private bank but in 1945 it was nationalized and became the state bank of Britain It is the bank of the Government The Government deposits with the bank its income from taxes and customs When your father pays his wireless licence or his income tax, the money goes to the credit of the Government at the Bank of England And the Government pays out by cheque on the Bank of England wages to the armed forces of the Crown, interest on the National Debt, and salaries to Ministers and M P s In addition, the big five themselves

bank at the Bank of England They open accounts with "the Old Lady of Threadneedle Street," as the Bank of England is called, just as people open accounts with them They pay their debts to each other by cheque on the Bank of England

Besides keeping money safe and lending money, banks do other useful services for their customers They can keep valuables, jewellery, deeds, or share certificates in safe custody in their strong rooms They will also arrange to pay their customers' regular subscriptions to clubs, societies, or insurance companies

BANKRUPTCY. When persons or companies find that they are unable to meet their debts, the law steps in The debtor himself, or one of his creditors, presents a bankruptcy petition to a court and the judge makes a Receiving Order, under which an Official Receiver takes control of the debtor's property On oath, the debtor makes a full statement of his affairs and he is publicly examined The creditors hold a meeting and call in the debtor. They can come to an agreement, that is, the debtor can make a "composition" with his creditors If the composition is accepted it receives the sanction of the court The debtor, for example, may agree that he can pay 15s in the £ on his debts, which the creditors accept If there is no composition, the court adjudges the debtor a bankrupt

The creditors then appoint a trustee of his property or business The bankrupt must give the trustee all the requisite information The trustee goes through the books, sees whether there has been fraud, and realizes the assets, that is, he may sell the property with which to pay the debts If the bankrupt tries to conceal any of them or to

run away, he may be imprisoned. If, later, he pays off his debts, he can apply for his discharge from bankruptcy, which, if it is granted, is an official acknowledgment that he is no longer in a bankrupt condition.

A bankrupt suffers from many disabilities. It is illegal for an undischarged bankrupt to contract a debt of £10 or over without disclosing his condition. He cannot sit in parliament or hold any public office.

BAPTISM is usually the sprinkling of the forehead with water, but sometimes complete immersion in water, as a sign of cleansing and to mark entry into Christ's Church. Baptism is commanded by Jesus, and was practised by the early Church. Until you are baptised you cannot receive the other SACRAMENTS.

BAPTIST CHURCH, one of the reformed Christian Churches. It requires that each of its members shall be baptised by the immersion of the whole body in water after he has given an account of his faith. The Baptist Missionary Society was founded in 1792, and has done important work. The great William Carey (1761-1834) was a Baptist, and pioneer missionary in India.

BARBADOS is an old British colony in the WEST INDIES, with a more temperate climate than most of the West Indian islands. Sugar, high-quality rum, molasses and cotton lint are exported. The capital is Bridgetown.

See map of CENTRAL AMERICA.

BARD, a wandering Celtic musician-poet, who composed verses on the deeds of famous heroes and sang them to the accompaniment of his harp. See also TROUBADOURS.

BARNACLE, a marine CRUSTACEAN often living in widespread clusters on rocks between tide-marks on piers or on the bottoms of ships. Each barnacle is free-

swimming when young, but settles down and forms a limy shell with a close-fitting lid. Under water the lid is raised, and the long, hair-fringed limbs comb minute particles of food into the mouth.



Barnacle catching food

BAROGRAPH See BAROMETER.

BAROMETER, an instrument for measuring the pressure of the ATMOSPHERE. There are two main types of barometer, the aneroid and the mercury. In the first, the atmosphere tends to crush a flexible flat tin which has a vacuum inside. The crushing is prevented by a stiff U-shaped spring. As the pressure on the tin alters, the spring is bent more or less. The spring movement, through a chain of levers, turns a pointer.

Instead of turning a pointer, the aneroid barometer can be made to operate a pencil which traces a line on a cylinder which is made to rotate slowly by clockwork, thus giving a permanent record of the pressure. This instrument is called a barograph (See p. 62).

The mercury barometer balances

the air pressure against that of a column of mercury. If the pressure increases, then the mercury is forced up the tube till a new balance height is reached. The illustration shows the common weather glass it has, floating in the open end, a weight which moving up and down with the mercury controls the movement of a pointer.

The barometer is an instrument used in METEOROLOGY.

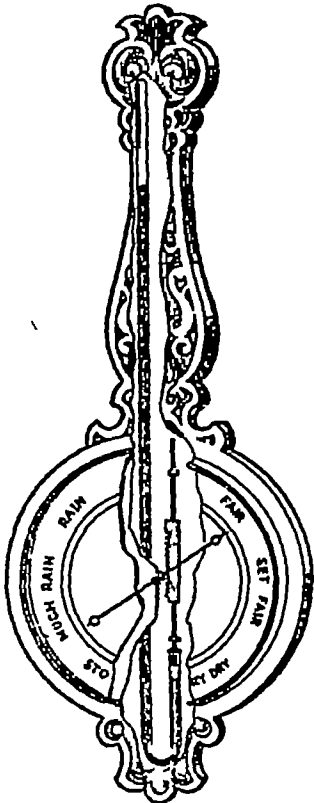
BAROQUE really means extraordinary or odd, and is applied to certain forms of ART which do not conform to the rules of classical art with its stately, restful and dignified style.

The baroque artist shows emotions in his art, even exaggerating dramatic effect by vigorous move-

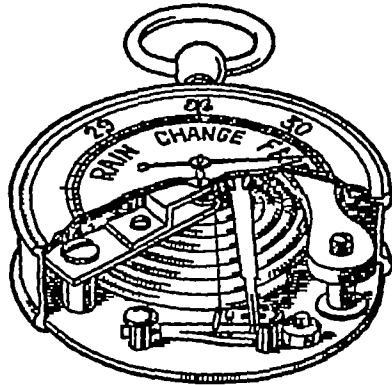
ment and strong contrasts of tone, colour and shape.

Michelangelo was the first to introduce this quality into his art (both in sculpture and painting), e.g. his "Last Judgment" painted on the ceiling of the Sistine Chapel in Rome. He was followed in this style by Tintoretto, a Venetian painter, and by El Greco, a Spanish master. But it was in the north of Europe that baroque found its real expression. The work of Rubens, the great Flemish master, is a good example, e.g. his well-known "Adoration".

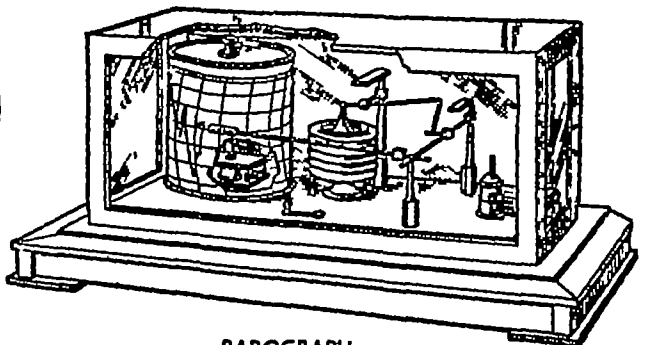
BARRIE, Sir James Matthew (1860-1937), was educated at Dumfries Academy and Edinburgh University, of which he was later Rector. At first a journalist, his



MERCURY
BAROMETER



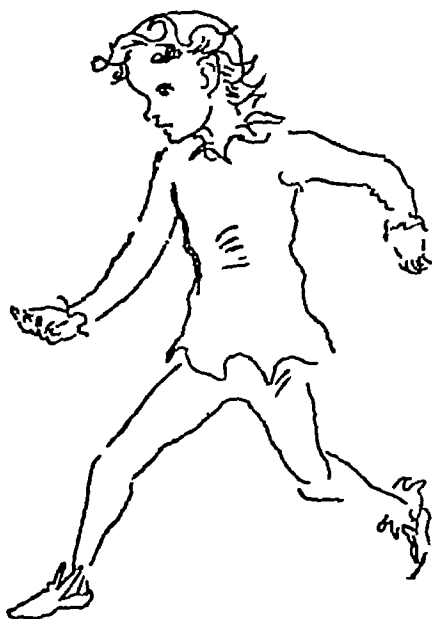
ANEROID
BAROMETER



BAROGRAPH

Barometers foretell the weather from changes in atmospheric pressure

reputation was made by his plays, particularly his *Quality Street*, *The Admirable Crichton*, *What Every Woman Knows*, and *Dear Brutus*. Most famous of all is *Peter Pan*, the play for children about the boy



Barrie's Peter Pan

who never grew up, Tinker Bell the fairy and the Darling family, who visited the Never-Never Land, peopled by Red Indians and pirates led by the ferocious Captain Hook. Barrie was a shy, sensitive and sentimental man with a whimsical fancy and sense of humour—all qualities evidenced in his writings.

BASE, in chemistry, a COMPOUND which combines with an ACID to form a SALT and water, e.g. sodium hydroxide (base) and hydrogen chloride (acid) form sodium chloride (salt) and water.

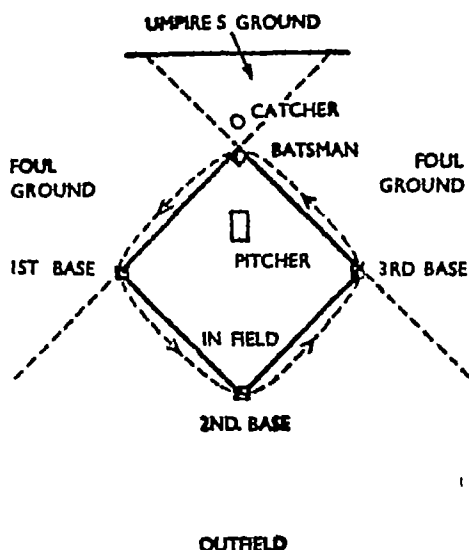
BASEBALL is the national game of America. It is played between two teams on a ground approximately 400 feet square, and the playing pitch is made up of an in-field and an out-field. The in-field

consists of a square with sides of 90 feet, as shown in the diagram on p. 64. In the top angle is the home base or home plate, the pitcher's plate is 60½ feet away. Bases are placed at each of the other angles of the square, and consist of a white canvas bag 15 inches square filled with sand. The two base lines running from the home base are continued beyond the first and third bases to the limits of the playing area, and they separate fair ground from foul. The playing area outside the square is the out-field.

The bat is 34 inches long, the ball 9 inches in circumference weighing 5 ounces. A team consists of nine players. One team bats while the other fields. The fielding side goes in to bat when three of the side batting first are out.

A game consists of nine innings each and is won by the team which scores most runs. A run is scored when a batsman has completed running round all the bases. The fielding side consists of the pitcher and the catcher, sometimes referred to as the battery, the first, second and third basemen and the short stop, who are known as in-fielders, and the right, left and centre fielders, called out-fielders, since their position is in the out-field. The pitcher delivers the ball either overhand or underhand to the batsman who stands in one of the rectangles 6 feet by 4 feet which are situated on each side of the home-base. The pitcher also acts as a fielder by stopping short hits known as bunts, and getting the batsman out by throwing the ball to the first base. If necessary, he covers the first base when the first baseman has left his base in order to field. The catcher stands behind the home-base and within 10 feet of it when the ball is delivered to the batsman. In addition to catching the pitcher's balls it is the

duty of the catcher to field to the first baseman short hits and to catch high foul flies which otherwise might travel a long distance. The second baseman plays at the back of the base line between the first and second bases. He fields, and



Plan of the baseball field

also covers the second base. The short stop's position is between the second and third bases and his work is similar to that of the second baseman. It is the duty of the third baseman to field ground balls. The out-fielders move about to intercept or catch long hits which come into their part of the ground.

The batter runs for the first base: (1) if he hits a ball in fair ground that cannot be caught or fielded before he gets there, (2) if the umpire calls four bad balls, (3) if struck by a pitched ball, (4) if the catcher fails to hold the third strike, so long as the batter can reach the base before the catcher has retrieved the ball, thrown it to the first baseman, and the first baseman has caught it and touched the base.

Fair balls are those which are batted into fair ground. Foul balls are all others. As soon as a batsman

has hit a fair ball he must start for the first base. On arrival at the base he may be touched "out" with the ball in the hand of a fielder unless some part of his person is in contact with the base.

A runner on the first base is free to run to the second base when the batsman hits a fair-ground ball, but if the batsman makes a fly hit, that is, a hit into the air, he is not forced to run. If there is a player on each of the second and third bases as well as the first, all are forced to run when the batter hits a fair-ground ball. When this takes place a runner can be put "out" if the ball is thrown to the baseman and held by him in the next base before the runner arrives.

BASIC ENGLISH consists of a vocabulary of about 850 very common English words which, it is claimed, are enough for writing or speaking about the ordinary things of everyday life. It is studied abroad both as an international language and as a basis for the further study of English.

BASKETBALL is a game played indoors between two teams of (usually) five a-side. At each end of the field of play, the court, is a basket, consisting of a net of white cord hanging from a round metal ring, the basket being suspended 10 feet above the ground and having a large white backboard behind it. The object of the game is to score a goal by getting a leather ball, about the size of a football, into the opponents' net. The team scoring the most goals wins. The players are either forwards, centres, or guards, and the referee starts the game by throwing the ball high up between two opposing forwards in the centre of the court. The ball may be batted, bounced, rolled, dribbled with the hand, or passed to another player, but a player may



Inside this steel ball (see BATHYSPHERE) scientists have descended far into the ocean depths, and seen in the searchlight beams strange, gleaming creatures to which they have given long scientific names, among them are angler fishes which grow a sort of rod, line, hook and lure to help them catch their prey



HAROLD SWEARS TO SUPPORT WILLIAM'S CLAIM TO THE ENGLISH THRONE



WHEN HAROLD ACCEPTS THE ENGLISH CROWN WILLIAM INVADES ENGLAND



WILLIAM DEFEATS THE ENGLISH AND HAROLD IS KILLED BY AN ARROW

Three portions of the Bayeux Tapestry, a pictorial record made in the eleventh century of events leading to the Norman Conquest of England. The pictures are made with coloured wools on a long linen scroll. The drawings above are based on a copy of the Tapestry in the Victoria and Albert Museum, London.

not run while holding the ball. A game consists of two periods of twenty minutes each, the players changing ends at half-time.

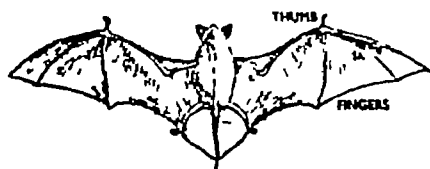
There are several slightly different versions of the game, which is now popular in very many parts of the world.

BASQUES are people living in the frontier regions of France and Spain along the Bay of Biscay. An ancient race, they are mainly agriculturists and fishermen, though many of them are miners in north-western Spain. The Basque language is unlike any other European tongue.

BASSOON See REED INSTRUMENTS

BASUTOLAND is a native African territory governed by local chiefs under a British Commissioner. Wool, mohair, wheat and maize are produced. See map of the UNION OF SOUTH AFRICA.

BAT, the only one of the MAMMALS which has the power of active



Formation of a bat's wings

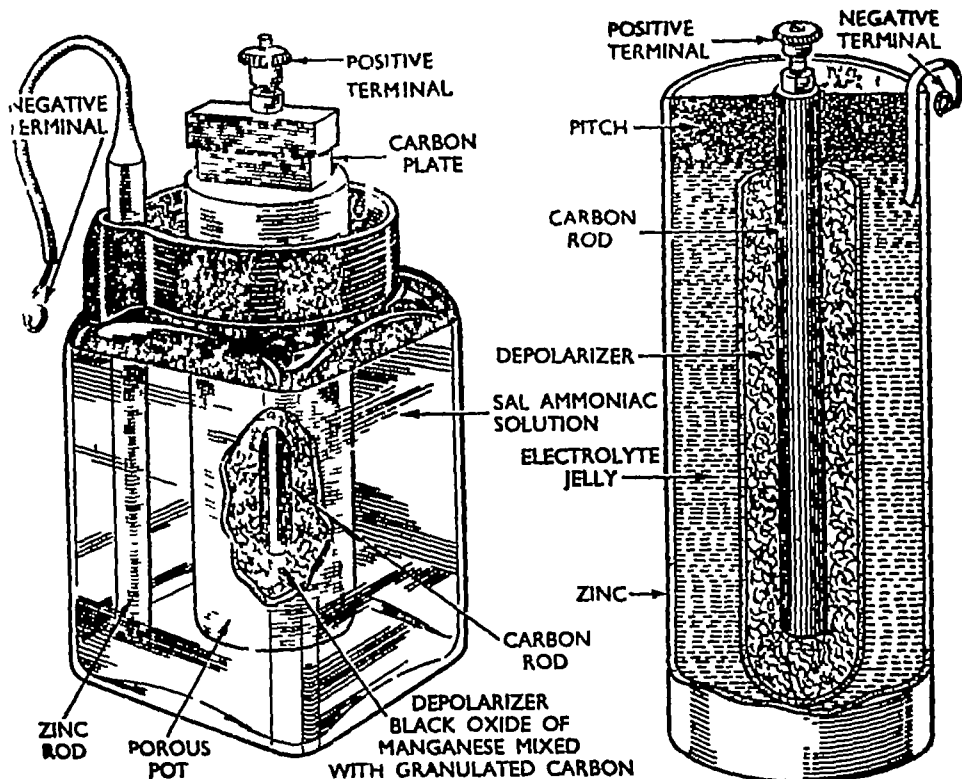
flight. A web of sensitive skin stretches between the bat's very long hand and finger bones, reaches across to the ankle and thence to the tail tip, and also from wrist to shoulder. At rest, the bat hangs up by its thumb claws, or upside down by its toes. Bats shelter in caves, hollow trees, etc., emerging at dusk to fly and feed on gnats, mosquitoes and other insects harmful to man.

BATHYSPPHERE, a ball-shaped steel chamber for lowering into the depths of the ocean with observers inside. Dr. William Beebe, Ameri-

can marine zoologist, has actually descended over half a mile under the water in his bathysphere, which was equipped with windows made of strong, thick quartz and had two powerful searchlights for lighting up the dark waters immediately in front of the bathysphere. Through these windows the scientists inside were able to examine the many strange creatures which swam into the light. The pressure of the water is very considerable deep down in the ocean, and the fishes' bodies must be capable of withstanding these enormous pressures, possibly in the lightly compressed water on top they would burst. It was noticeable that many of the fish glowed as they darted about the darkness, the glow being a lure to attract unwary smaller fish which were to provide the next meal.

Another attempt at deep-sea exploration was the construction by the Belgian Professor Piccard of a "bathyscaphe," having a chamber for two observers with a large metal casing on top filled with oil lighter than water. The vessel had heavy ballast outside to make it sink—this could be released to let it rise, and propellers turned by electric motors to drive it along under water.

BATTERY, ELECTRIC, a contrivance for making electricity by chemical means. In its simple form it consists of two plates in a chemical solution which attacks one of the plates more than the other. The Leclanché cell is a common type, and will serve as an example. The illustration shows an outer glass pot containing (1) a rod of amalgamated zinc, the negative pole, (2) a carbon rod, the positive pole, held usually in a porous pot which is packed around with crushed carbon and manganese dioxide, (3) a strong solution of sal-ammoniac, which reacts with the zinc to form zinc



Inside the wet and dry batteries, with names of the parts

chloride The zinc is protected from useless corrosion when the cell is not being used by being amalgamated, i.e. its surface is combined with a small quantity of mercury. The carbon rod, the positive pole, is unaltered in use. The packing around it absorbs and removes the hydrogen produced during the operation. Owing to the slowness with which this occurs, the current from such a cell decreases if it is allowed to pass for long, but will recover after a rest. This type is called a wet battery. See BELL (ELECTRIC).

The so-called dry cell, which is used for torches and wireless sets, has exactly the same action, but its construction is somewhat different. The whole outer case is of zinc, and the sal-ammoniac is not in a liquid solution but is contained in a jelly which saturates the space around the central carbon and its

packing. This type of battery, having no liquid to spill, is portable.

BAUXITE is the chief ore of ALUMINIUM, which is obtained from it by ELECTROLYSIS.

BAY, an inward curve of the coast. It can be as large as the Bay of Biscay or as small as a bathing beach. A large deeply indented bay is sometimes called a gulf. See also FIORD.

BAYEUX TAPESTRY. When WILLIAM I conquered England, a pictorial record of the event was made with coloured wools on a long linen scroll, the scroll being about 231 feet long by 19½ inches wide.

It begins with a picture of Edward the Confessor talking to Harold and then shows Harold going to France, being arrested by the French Count Guy, and his rescue by William, Duke of Normandy. Harold assists William in

his campaign in Brittany, is knighted by him, and swears allegiance to him, probably promising to support his claim to the English throne. Harold returns to England and on Edward's death assumes the English crown. William, hearing of this, builds a fleet and invades England, defeating and killing Harold near Hastings.

BEAR Unlike the allied cat and dog families, bears are largely vegetarian. Once brown bears lived freely in England, now few remain in Europe. Small bears live in the Himalayas, Malaya and Japan, the larger black bear and enormous grizzly are found in North America—the former becomes quite friendly, though untrustworthy, in national parks, but the grizzly with its huge claws and powerful hug is a very dangerous animal. The polar bear is the biggest, and catches seals and fish among the ice of polar seas. Bears walk on the soles of their feet. They are good at climbing, digging or swimming. A common sport in the Middle Ages was bear-baiting, in



Curving coast forms a bay

which a bear, chained to a pole, was set upon by a pack of dogs.

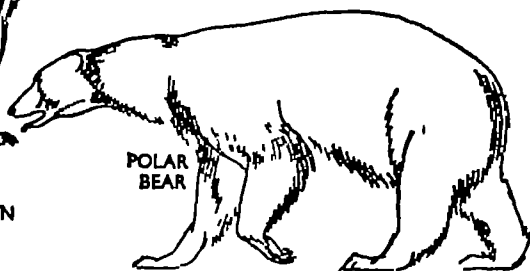
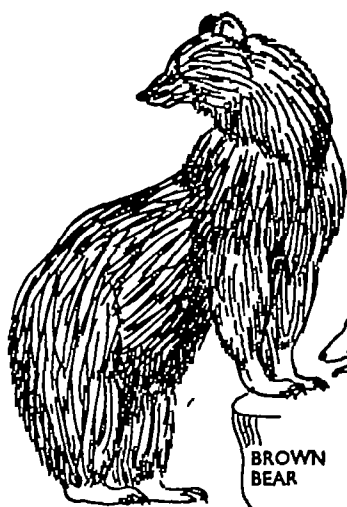
BEASTS OF BURDEN See TRANSPORT

BEAVER See RODENT

BECHUANALAND is British territory in the south of the African continent. The southern part, British Bechuanaland, is part of Cape Province, while the northern part, Bechuanaland Protectorate, is a Crown colony. See map of the UNION OF SOUTH AFRICA.

BECKET, Thomas (1118–1170), Archbishop of Canterbury in the reign of HENRY II.

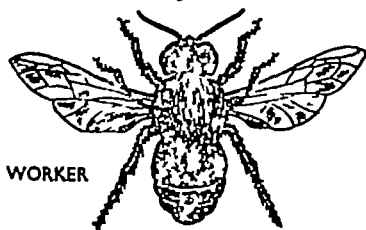
BEE, ant, wasp, and hornet form the INSECT order with the most highly-organized social life. There are thousands of species, with widely differing habits. The fore and hind wings are linked together.



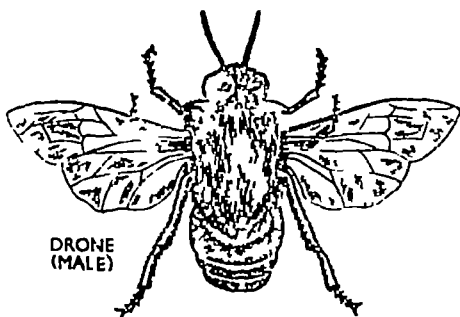
The brown bear likes warmer lands than his white polar relation

in all these insects. Many types live in enormous colonies made up of three grades of insect: the workers, drones or males, and queens. Queens, of which there is normally only one to a hive of bees or nest of ants, usually have a mating flight and then spend most of their lives laying eggs. The eggs hatch into legless grubs, which later turn into pupae. See METAMORPHOSIS. Great care is taken of the young.

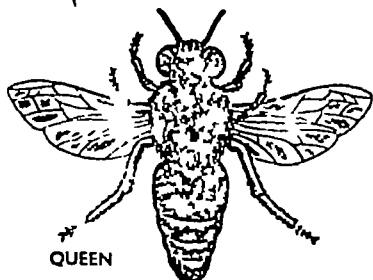
Ants' nests are usually made of earth, bees' nests of wax, while wasps form a papery substance from chewed wood. Honey made by hive bees is important to man, the worker bees collect pollen and nectar from flowers to make it. Pollen is made into bee-bread for the larvae, while nectar is converted into honey for winter use.



WORKER

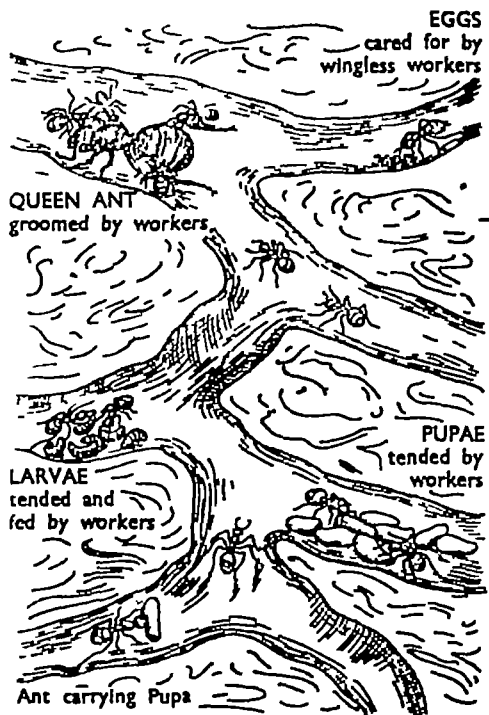


DRONE
(MALE)



QUEEN

Three kinds of bee in the hive



Organized life of the ant

Many kinds of bumble-bee make underground nests. The black and yellow wasps are useful in destroying harmful insects, though later some eat fruit. Hornets, the largest species of social wasp, are brown and yellow coloured, with a severe sting. White ants or termites, which cause great destruction in tropical countries, are insects but not related to true ants.

Ants live in very highly developed communities. There are three kinds of ant—workers, who have no wings, and males and females, who have wings for a short time. The males and females are responsible for producing the eggs from which come new ants, but the work of the community is done entirely by the workers, who burrow holes in dead trees and in the ground in which the ants live and look after their eggs. Some of the workers form a body-guard and protect the ant community when it is attacked by enemy.

ants Red ants, for example, often carry off the eggs of some other species, hatch them out in their own nests and make the new ants work as slaves for them

Ants are very fond of sweet things, and actually capture the green-fly that you find on rose bushes, taking them home, keeping and feeding them and "milking" them for the sweet juice that they possess!

In Central and South America live the Foraging Ants these travel about in long columns just like an army on the march, and wherever they go they eat everything softer than metal or stone, so that other insects, animals and

human beings flee when they know that these ants are coming their way

BEETHOVEN, Ludwig van (1770-1827), was born in Bonn, Germany, the son of a poor musician. As a young child he learnt the violin and piano. In his early twenties he began to make himself known as a musician, and went to Vienna to study, eventually settling there. He was at first a pupil of HAYDN, but the two men did not get on well together. During his life in Vienna he composed his symphonies, sonatas (see FORM IN MUSIC), CHAMBER MUSIC and choral works, which, as they became known, brought him

increasing fame. Beethoven played and conducted his own works, until he was overtaken by the most tragic fate that can befall a musician—he became deaf and could no longer hear the sounds he composed. Yet he went on composing, hearing the sounds in his mind, only his mighty spirit enabled him to continue as a composer when other men so afflicted would have given up. Beethoven began composing by imitating the manner of his great predecessors, Haydn and MOZART, but as he developed to maturity he created his own style of composition, and he is recognized today as one of the very greatest of composers. To enjoy his music, we must appreciate the way in which its various sections are contrasted and balanced with one another and the skill with which it has been built up, as by an architect in sound.



Beethoven composing his early symphonies

BEETLE, an order of **INSECT** having the first pair of wings converted into wing-covers, under which the second pair is folded. The external skeleton is generally very hard and often has a metallic sheen. Ladybirds are useful beetles, feeding on greenfly, both as larvae and adults. Many beetles do great harm to crops, such as weevils in cotton or grain, and Colorado beetles in potatoes, while others, including the death-watch beetle, destroy furniture or timber. Other common beetles are the cockchafer, meal worm (larval stage), the light-producing glow-worm, whirligigs and great water-beetle.

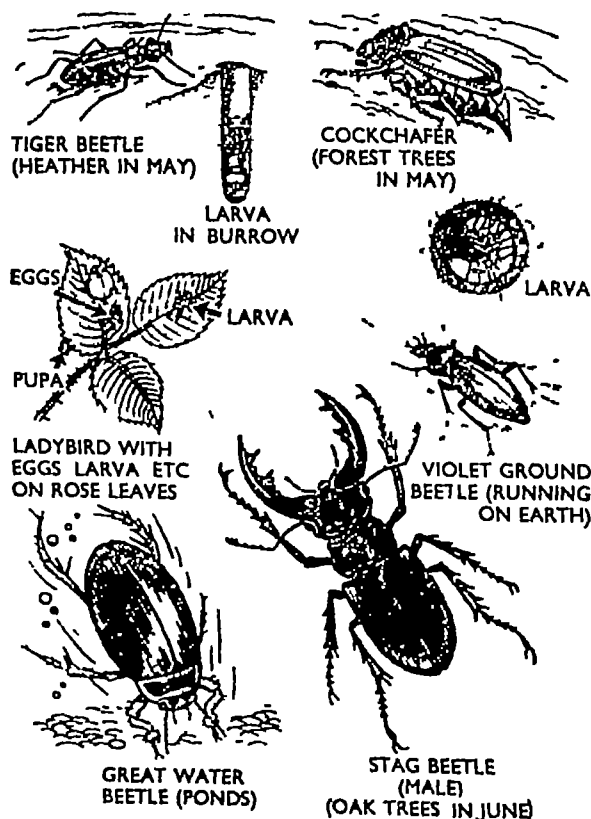
BELGIAN CONGO, a large inland area of West Africa drained by the Congo and its tributaries, consisting mostly of forest. Oil-palm products and gum copal are

produced, but more important are copper, radium and diamonds. The capital is Leopoldville on the Congo. See map of **AFRICA**.

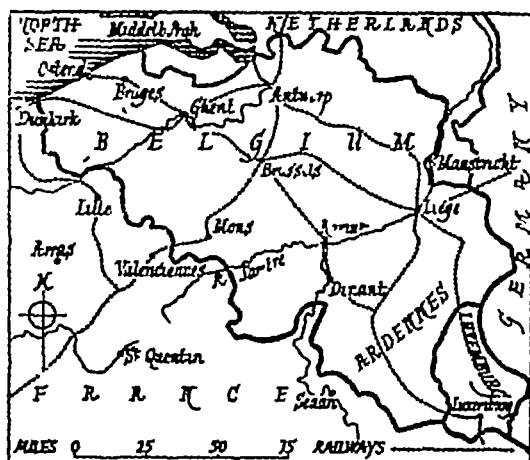
BELGIUM is an independent kingdom on the North Sea coast. People in the north speak Flemish, those in the south, the Walloons, speak a dialect of French. The **PLATEAU** of the Ardennes in the south is partly forested and partly sheep-rearing country. The coal-field farther north supports varied industries, and the region of Flanders between the coalfield and the sand dune belt along the coast is under intensive cultivation. Belgium is one of the most densely populated countries in Europe. The chief towns are Brussels, the capital, Antwerp, one of Europe's largest ports, and Liège, an industrial and mining centre. Belgium also controls the **BELGIAN CONGO**.

History Belgium has been called "the Cockpit of Europe" because it has been the scene of so many battles. From 1815 to 1830 Belgium was united with Holland to form the Netherlands, then it became independent, and its security was guaranteed by Britain, France, Austria, Prussia, Holland and Russia in the Treaty of London (1839)—the famous "Scrap of Paper" which Germany ignored when in 1914 German troops invaded Belgium, and so opened the First World War.

In May, 1940, during the Second World War, Belgium was again invaded by German troops. The Belgian army, assisted by British and French forces, resisted for a time, but



Common beetles and where they may be found



Belgium, scene of many battles

when overwhelmed surrendered to the invaders. The whole of Belgium was occupied by the Germans until 1944, when the Allies drove out the enemy, Brussels being freed on September 3rd, 1944.

BELL, A Graham (1847-1922), was the Scottish inventor of the TELEPHONE, and the first man to transmit speech by electricity.

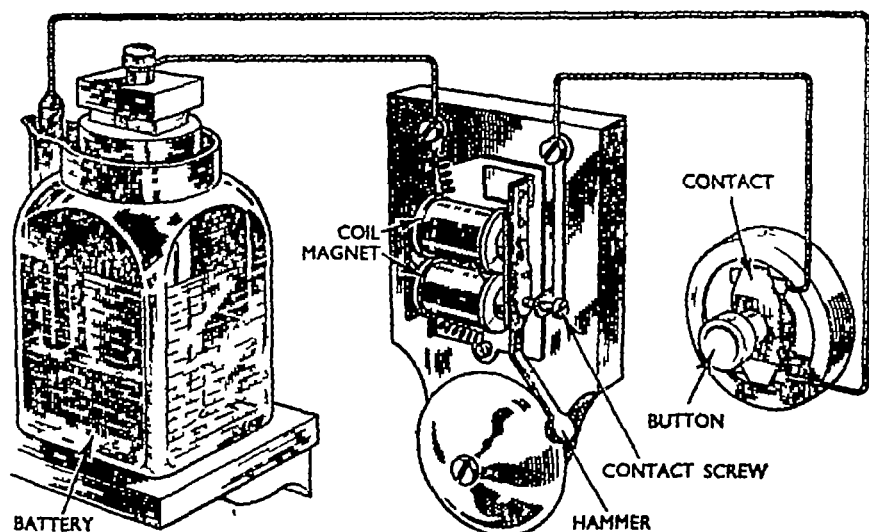
BELL, ELECTRIC When a current passes through the coils of an

ELECTROMAGNET, any piece of iron nearby is attracted towards the core of the magnet. When the current ceases the attraction stops.

When you press the button of an electric bell, you make contact between two wires and so complete an electric circuit. The coil magnet is at once magnetized and attracts the hammer of the bell. But the movement forward of the hammer at once breaks the circuit by coming away from the contact screw. The circuit being broken,

the magnet no longer attracts the hammer, which flies back to its original position. Here it completes the circuit again, and is again attracted to the magnet. Each time the hammer moves forward it strikes the bell and breaks the circuit, then jumps back and completes the circuit, then moves forward and so on, thus producing the rapid burr-r-r.

BENZENE or benzole (not to be confused with BENZINE, which is



Press the button and the electric bell circuit is completed

entirely different) is an ORGANIC liquid, boiling point 80 deg C, which is obtainable from COAL DISTILLATION It is used as a SOLVENT and in motor fuel

BENZINE is a mixture of liquid HYDROCARBONS which boils around 120 deg C It is derived from petroleum and used as a fuel and SOLVENT Abroad the name is used for the liquid which we call petrol It is not to be confused with BENZENE

BEOWULF See ENGLISH LITERATURE

BERING STRAIT is a channel which connects the Pacific and Arctic Oceans and separates Asia from Alaska

BERLIOZ, Hector (1803-1869), was a French composer and great experimenter in orchestration He sought much of his inspiration from ROMANTIC subjects outside music, being from time to time influenced by Shakespeare and others Often heard today are his overture, the "Roman Carnival", his opera "Benvenuto Cellini", his "Fantastic Symphony," in which he depicts the life of an artist, and his "Hungarian March"

BERMUDAS, a densely-populated British Crown colony consisting of a group of coral islands in the Atlantic near the east coast of the United States It is a British and American naval and air base besides being a tourist centre The capital is Hamilton

BHUTAN is an independent state bordering India on the forested southern slopes of the Himalayas east of Mt Everest Rice, maize and millet are grown in the valleys See map of INDIA

BIBLE, THE, is a collection of sixty-six books divided into the Old and New TESTAMENTS (See also COVENANTS) In the Christian faith it is a record of how God gradually

showed men what He was like and what He expects the character and conduct of men to be The New Testament in particular shows God's plan carried out through the coming of Christ

All the original manuscripts of the books are lost, but by A D 405 St Jerome's translation into Latin was completed, and from this version Wycliffe and his followers rendered the entire Bible into English in the 14th century In 1525 William Tyndale's version of the New Testament was printed at Cologne In 1535 Miles Coverdale's complete translation appeared, and his version of the Psalms was used in the Prayer Book

In 1604 James I called a conference between the High and Low parties in the Church Forty-seven revisers were appointed, who divided the Bible between them The outcome in 1611 was the Authorized Version which follows Tyndale's version closely, and is still used

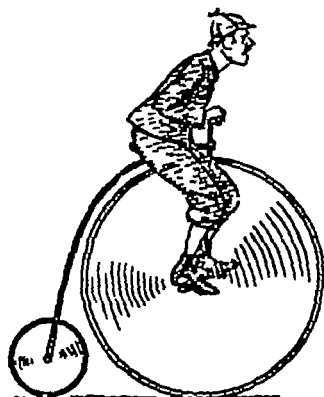
In 1881 the Revised Version of the New Testament appeared, and in 1884 of the Old Testament Since then various renderings into modern English have been made in recent years

The Roman Catholic Church produced its own English translation, the Douai Bible, the New Testament in 1582 and the Old Testament in 1609-1610.

BICARBONATE OF SODA is a compound of sodium which when heated gives off carbon dioxide It is therefore used in baking powder Mixed with solid acids it is the basis of effervescent drinks, since in solution the acid combines with it to give off carbon dioxide Being a mild ALKALI it is used for stomach disorders caused by excessive secretion of hydrochloric acid It is sometimes used in fire EXTINGUISHERS



DANDY-HORSE



PENNY-FARTHING OR
ORDINARY



MODERN SAFETY
BICYCLE

Development of the bicycle

BICYCLE The oldest bicycle was the "dandy-horse," which had no gears or pedals but was pushed along by the rider's feet. Then came the old "penny-farthing," in which pedals were fixed to the front axle. The front wheel was made as large as possible to get high speeds, and as a result it became very liable to pitch forward. Chain gears gave us the modern safety cycle with its

high speed and lightness. See also RATCHET WHEEL and CYCLING.

BIENNIALS are plants which are sown during the summer of one year and develop to produce flowers and seed during the following year, after which they die, e.g. antirrhinum, Canterbury bell, foxglove, wallflower.

BILL OF EXCHANGE, used mainly for foreign or international trade. We can best understand what it is and how it works from an imaginary example. Let us suppose that Messrs John Bull of Britain have sold to Messrs Uncle Sam of America goods to the value of £10,000. Messrs John Bull will draw a Bill of Exchange on Messrs Uncle Sam ordering them to pay £10,000 in, say, three months' time. Messrs Uncle Sam will accept this Bill of Exchange. They will write across it "Accepted," and sign their name. They are now liable to pay to anyone who presents this Bill the sum of £10,000. Messrs John Bull can put this Bill away in their safe, wait three months, and cash it for £10,000. The transaction would be completed. But Messrs John Bull may prefer to have the money immediately. They can go to their BANK, and the bank will buy this Bill from them, that is, it will discount it for them. It will pay £10,000 less interest on it for three months.

There are special discount houses which specialize in this kind of business, but banks are increasingly acting as discounting houses. In our transaction Messrs John Bull have sent goods to Messrs Uncle Sam and have received in return not money now, but the right to receive money in three months' time. Actual payment will depend on whether Messrs Uncle Sam can pay in three months' time. If there is any doubt Messrs Uncle Sam

may get a well-known firm to add their name to the Bill which will give it greater certainty of payment, or they may go to an accepting house (which specializes in accepting bills). This firm, for a consideration, will allow the Bill to be drawn on them.

When it comes to payment, instead of sending money across the Atlantic, Messrs Uncle Sam in America may go and buy Bills for an equal amount which have been drawn on English firms by, say, an American exporter of raw cotton to England, who wants payment from England for his cotton. Messrs. Uncle Sam buy these Bills, send them to Messrs John Bull, and so pay them for their goods. Messrs John Bull will prefer this method of payment, for they can cash these Bills in England, in English currency, with the English importers of the American cotton. So payment by bill of exchange has two advantages: (1) each exporter gets paid for his goods in his own currency, the English exporter in pounds, the American exporter in dollars, (2) no money has to be sent either way.

BILL OF LADING, a document which is given by the shipowner to the shipper of goods, stating (1) that he has received the goods to be shipped—it acts firstly, then, as a receipt, (2) that the shipowner is going to charge so much money for carrying the goods—it acts secondly, then, as a contract between shipper and shipowner, the shipowner to carry the goods, the shipper to pay so much for his doing so, (3) to whom the goods shipped belong.

BILLS, PROCEDURE IN PASSING. A *Bill* is a proposed new law, it is only after it has been passed by Parliament and has received the King's signature that it becomes an *Act*.

Bills are of two kinds: public and private. Public bills are concerned with national matters, while private bills relate to the affairs of towns or localities, as when a town desires authority to build a new harbour or new reservoir.

There are five stages in the passing of a bill through the HOUSE OF COMMONS: (1) *First Reading*. This is purely formal and enables the bill to be printed for circulation among the Members. (2) *Second Reading*. The general principles of the bill are debated and the bill rejected or accepted as a whole. (3) *Committee Stage*. The bill is considered in detail, clause by clause, by a Committee of the House, or by the whole House sitting as a Committee. Amendments may be proposed, accepted or rejected. (4) *Report Stage*. The Committee reports on its findings. (5) *Third Reading*. The bill, as amended or otherwise, comes up for its third reading.

If it is accepted, it goes to the House of Lords where it passes through the same stages. When accepted by both Houses (or in certain circumstances by the Commons alone—see PARLIAMENT) it receives the King's assent and becomes law.

BIOCHEMISTRY is that branch of chemistry which deals with those substances which affect, or are found in, living matter.

BIOLOGY is the science of life, the study of both animals (ZOOLOGY) and plants (BOTANY), with reference to their structure, ways of life, relationships and dependence on one another.

BIRD, a warm-blooded, egg-laying class of vertebrate (backboned) animals, in which the fore-limbs form wings and the mouth a beak. The beak may be used for catching food and for carrying it to the young,

for nest-building, for preening or as a weapon. The scaly legs bear four-clawed toes. Feathers give a streamlined contour in flight, provide a large surface area for the wing, and retain warmth. They are kept in good condition by oil from the preen-gland above the tail. British birds may be resident (remaining all the year), summer or winter migrants, or casual visitors. Birdwatching is the methodical observation of the habits of wild birds to find out something about them, a popular open-air hobby. See also **CAGE BIRDS**, **MIGRATION** and pictures on pp 76 and 77.

BISHOP England is divided for Church purposes into dioceses, each with a bishop in charge. Only a bishop can ordain men as priests and deacons, and administer confirmation by the laying on of hands.

BIZET, Georges (1838-1875), French composer mainly known to audiences today by the two suites from his incidental music to **DAUDET's** *L'Arlésienne*, and his stirring opera *Carmen*, about a Spanish gipsy girl and a bullfighter.

BLACKBIRD, a very common BIRD of garden and hedgerow. The cock is black with orange bill and a lovely mellow song, while the hen is dark brown. The rattling alarm note is often heard.

BLACK DEATH, the name given to a terrible pestilence which swept over Europe in the middle of the 14th century. It reached England in 1349, and more than one-third of the population—which at that time numbered only four millions—perished.

Most of the people then were villeins, tied to the estate on which they were born, but where the lord of the manor perished, the villeins wandered away to seek work elsewhere. The lack of labourers to till

the ground led to scarcity of food, and landowners offered high wages to get the farm work done, although Parliament tried to prevent this by passing the Statute of Labourers. Some landowners freed the villeins from service and allowed them to pay rent for their land instead of working on the lord's land. On some manors the fields were enclosed, or hedged, to make large sheep-farms. Fewer labourers were needed for tending sheep than for growing corn, and English wool fetched high prices on the Continent.

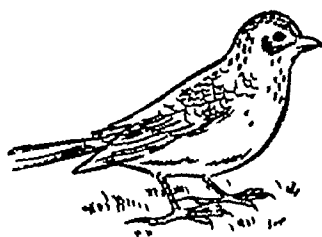
So the Black Death encouraged the break-up of the **MANORIAL SYSTEM**. Attempts to return to old conditions led to the Peasants' Rising (1381).

BLACKLEAD is plumbago or graphite, a soft, natural form of carbon. It is ground and baked with clay to make pencil leads. Mixed with a liquid it is used as stove polish. Mixed with oily material it is a valuable high-pressure **LUBRICANT** in engines.

BLAKE, William (1757-1827), was a man of extraordinary and



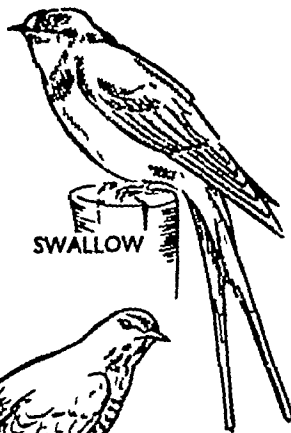
William Blake, painter-poet



LARK



CHAFFINCH



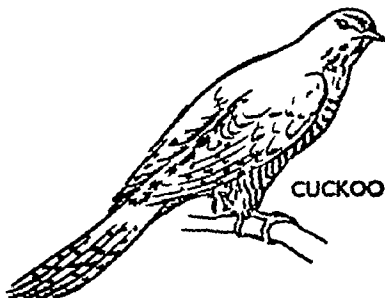
SWALLOW



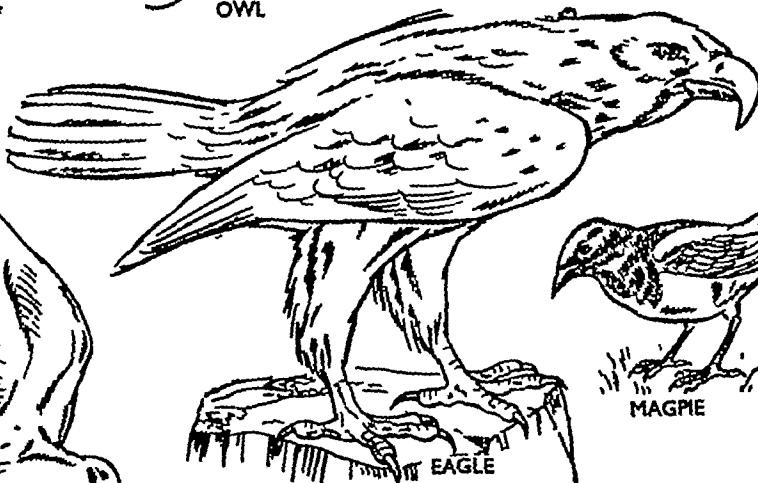
BARN
OWL



TAWNY
OWL



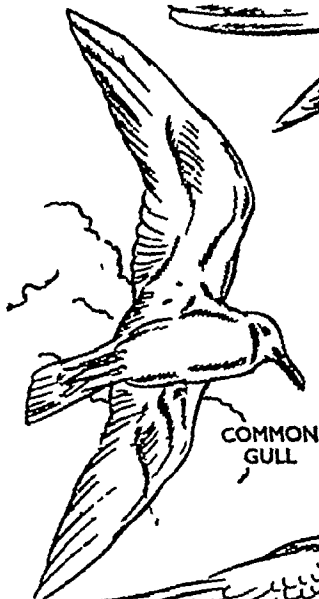
CUCKOO



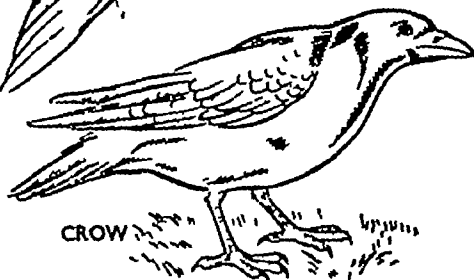
EAGLE



MAGPIE



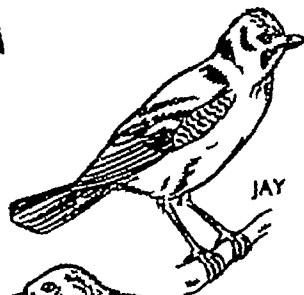
COMMON
GULL



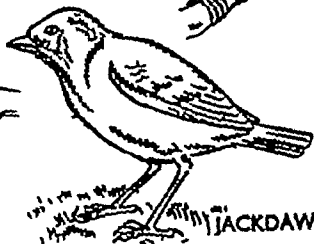
CROW



ROOK



JAY

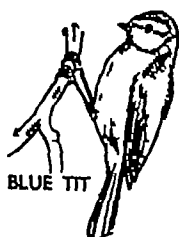


JACKDAW

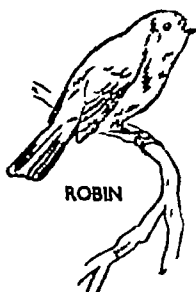
All these birds are seen in Britain, though some only rarely. Certain birds are resident all the year, others are visitors. The smaller birds have been



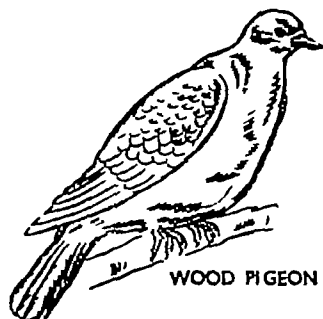
GREAT TIT



BLUE TIT



ROBIN



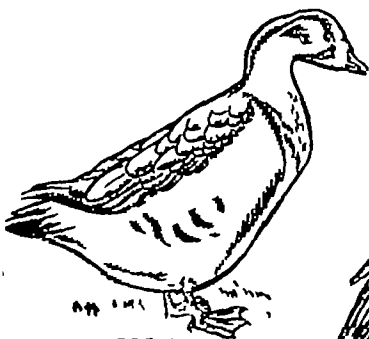
WOOD PIGEON



KINGFISHER



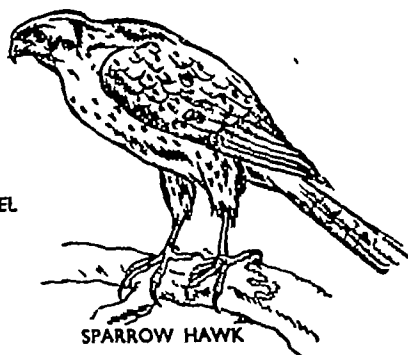
SONG THRUSH



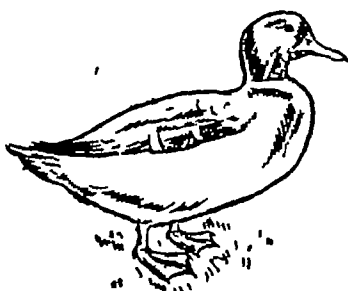
GOOSE



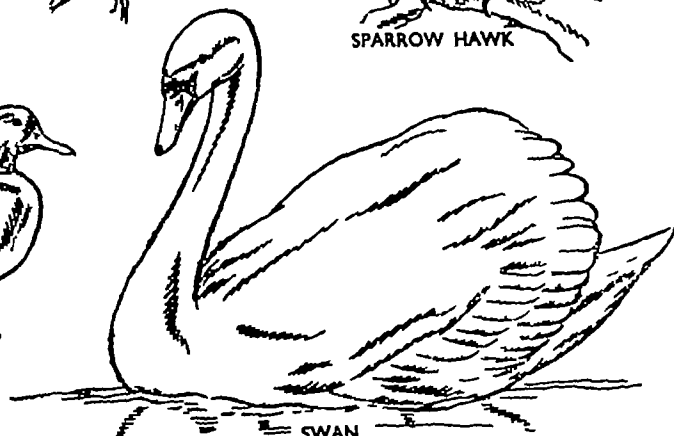
KESTREL



SPARROW HAWK



MALLARD

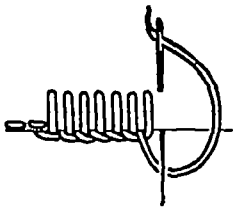


SWAN

*drawn larger in proportion to the others to show their details more clearly
Watching birds to find out their habits is an interesting hobby See p 74*

eccentric genius both as poet and painter His lyrics, so simple—even childlike—express a flaming hatred of injustice, cruelty and intolerance, and an equal love of their opposites In 1789 appeared a collection of lyric poems, *Songs of Innocence*, and in 1794 *Songs of Experience* These two volumes include such poems as "The Lamb," "The Laughing Song," "The Tiger" and "The Little Black Boy" His longer "prophetic" works, such as *Tiriel*, are however more obscure Such was his imagination that his "visions" were as real to him as people, and he frequently drew "ghosts" His paintings and illustrations are colourful, strangely powerful designs

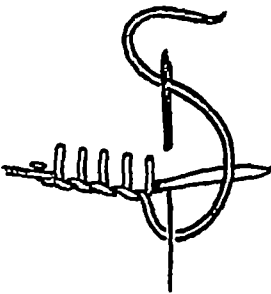
BLANKET STITCH is worked from left to right on the right side



Blanket stitch

of the material Begin with a **BACK STITCH** and work as shown. The stitches are of the same depth and are equally spaced, but for decoration

some variation in the length of stitch may be introduced Blanket stitch is one variety of **BUTTON-HOLE STITCH**, but it has a rolled edge and not a knotted one

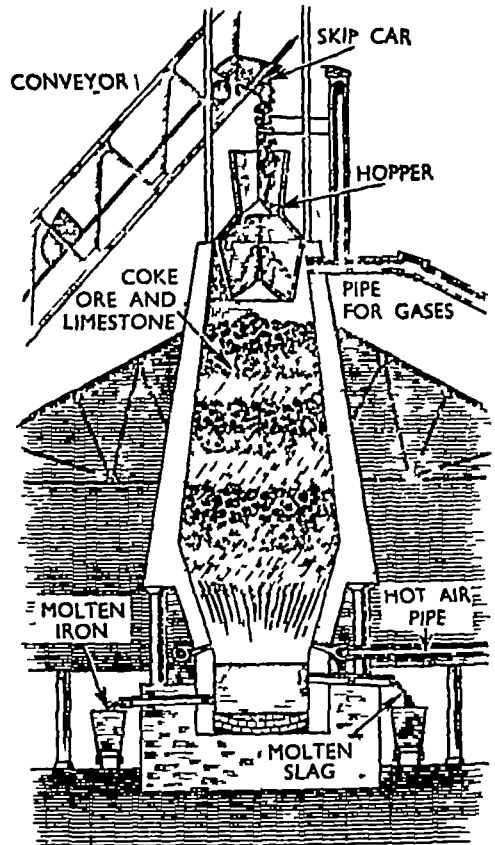


Mending a tear

Blanket stitch can also be used for mending a tear

BLANK VERSE See **PROSODY**

BLAST FURNACE, used for the extraction of pig iron from iron ore The ore, mixed with coke and limestone, is put in at the top Once



Blast furnace extracting iron

lit, the materials are kept active by a blast of hot air As a result of the heat and chemical action, molten iron collects at the base of the furnace, and molten slag floats on it Both these are tapped out from time to time, and the iron is eventually poured into moulds where it solidifies

BLOOD consists of a yellowish, saline fluid, the plasma, containing minute cells, the red and white corpuscles Red corpuscles number about five million per cubic millimetre, are disk-shaped and hollow on both sides, and carry haemoglobin This last is an iron compound which can take up oxygen and convey it to the tissues Red corpuscles are formed in bone marrow, and each lives only a few weeks In every cubic millimetre of blood there are seven to ten thousand

white corpuscles, which fight invading bacteria, in the blood or at a wound.

Other functions of the blood are to take waste carbon dioxide to the lungs, to carry food round the body, to transport waste matter to the liver and kidneys, to receive secretions from the ductless glands, to protect the body against bacteria and to regulate its temperature

A full-grown human body contains about ten pints of blood (See CIRCULATION OF THE BLOOD) If a person is wounded his blood has the power of clotting, the serum separates out and a semi-solid substance is formed which helps to prevent further loss of blood. Lost blood can be replaced by transfusion, in which another person's blood is injected into the veins

There are four main classes of blood, and only blood from certain groups will mix with blood from certain other groups. Blood from group IV can be used for any other group

BLOWLAMP, a lamp in which petrol or paraffin is forced through a vaporizer by air pressure from a pump at the side. The vapour rushes through a nipple, mixing

with air and providing a very hot flame which can be directed on any spot. A methylated spirit flame sets fire to the vapour in the first instance. The blowlamp is much used by plumbers and mechanics.

BLUE, an Oxford or Cambridge student who represents his university at certain sports, so called from the colours he is entitled to wear—light blue for Cambridge and dark blue for Oxford

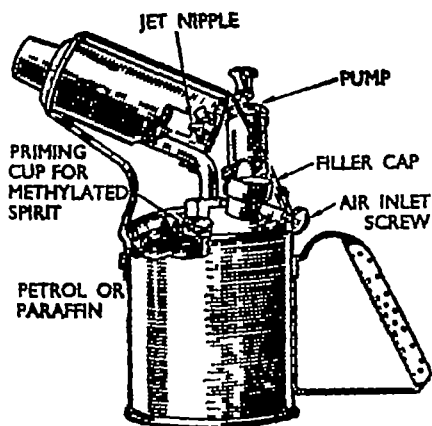
BLUESTOCKING The name was first used to ridicule a club formed for literary discussion by a Mrs. Elizabeth Montagu about 1750. A gentleman had attended one of her fashionable gatherings clad in blue worsted stockings instead of the conventional black silk and this had amused London society. The term was soon applied to any woman with an intellectual interest in literature

BOADICEA. See ROMAN BRITAIN

BOATING is a pleasant pastime for people living near a lake or river. Four types of boat are to be seen—the dinghy, for rowing, or perhaps sailing, the canoe, in which the canoeist paddles facing the front, the punt, propelled by a paddle or by a long pole in shallow water, the racing skiff, with fixed or sliding seat, for one or more oarsmen. With dinghy, canoe or punt, it is possible to make extended tours along inland waterways, seeing the country by canal and river, stopping at night at riverside inns, or CAMPING on the bank at permitted places, or even sleeping in the boat under a waterproof awning

BOER WAR See UNION OF SOUTH AFRICA

BOILER, a vessel in which water or other liquid is strongly heated. In some boilers, such as those used in houses for hot water or radiators, the water only gets very hot and does not actually boil. But in steam



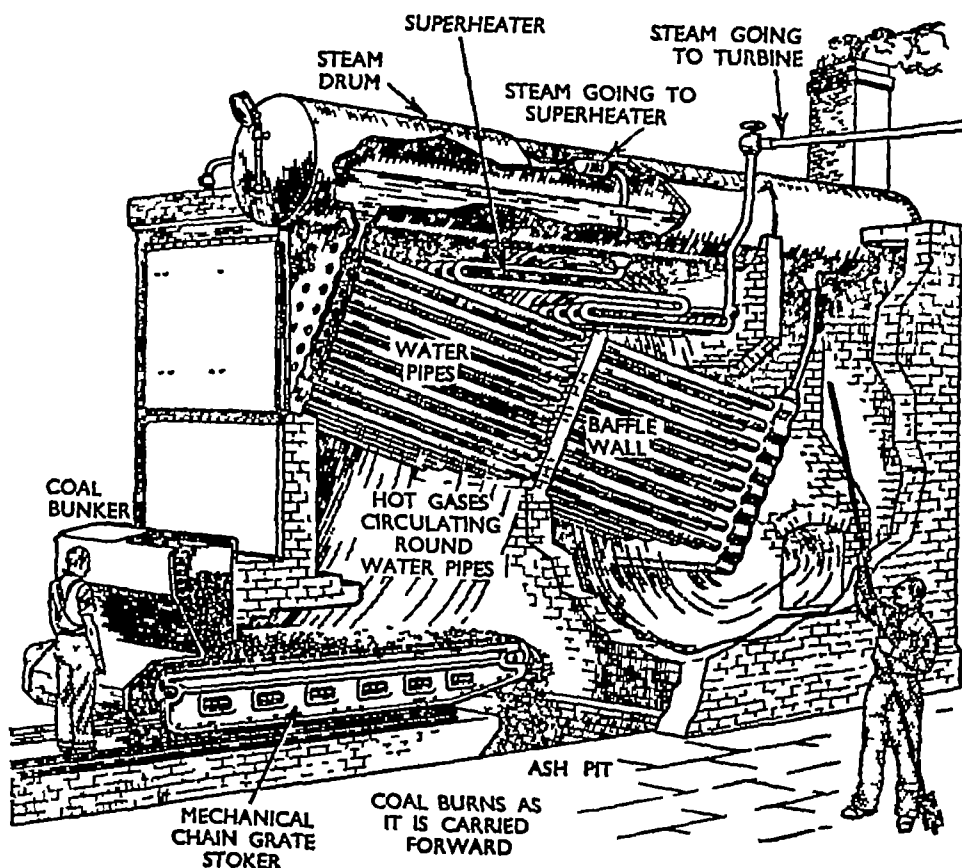
Parts of the blowlamp

boilers the heat is so intense that the water turns to steam To make this happen as rapidly as possible the flames often pass through tubes through the middle of the water, in other boilers the water is passed through steel tubes surrounded by hot gases, as in the illustration the steam here passes through a super-heater, to emerge hotter still and drier, and it then goes to drive the TURBINE

BOLIVIA is an inland South American state, extending across the Andes to the central swamps Its mineral wealth is very great, and tin, copper, silver and other minerals are exported Cereals are grown, but agriculture is in a backward state La Paz, the capital, lies in the Andes at a height of over

12,000 feet See map of SOUTH AMERICA

BOOK. The book as we know it is a comparatively modern invention In ancient Babylonia and Assyria a book was a tablet of baked clay with signs engraved upon it In Egypt it was a parchment made from the *papyrus* reed (hence the word "paper") attached to, and rolled round, a stick like a wall map. So too in Greece and Rome In early Christian times the *codex* appeared, a number of parchment sheets with a wooden cover it was handwritten and often beautifully decorated with coloured and gold-illuminated pictures and fancifully adorned capital letters The copying and ILLUMINATION of manuscripts was the work of monks



In this boiler water is heated to steam for driving a turbine

Printed books appeared in Europe in the 15th century. In shape and size they copied the appearance of the old manuscripts. In the 16th century they became smaller and the covers of leather and board were decorated. In the 19th century cloth bindings were used. The increasing use of machinery caused books to be cheaper and more numerous.

See PRINTING

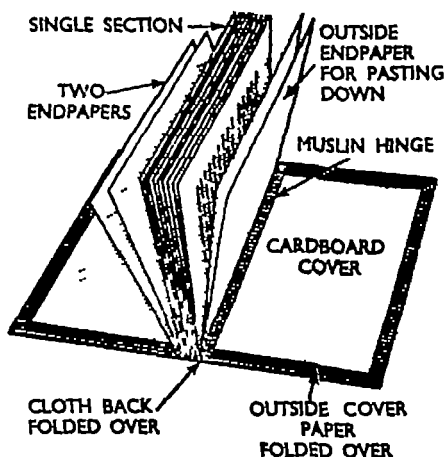
BOOKBINDING is a craft which needs great accuracy but is well worth while. It is possible to make your own books, to cover new ones, or re-cover those whose covers have become shabby.

If you are putting a fresh cardboard cover round an old single-section book, first remove the old cover, any stitching, and the endpapers, those stiff pages often coloured or patterned just inside the book and stuck on the inside of the covers.

For new covers you need some linen thread, two double-page endpapers, a strip of stiff paper, a muslin strip, two pieces of cardboard, a strip of bookbinding cloth for the back, two pieces of coloured paper.

To assemble, fold new coloured endpapers round the section, fold a strip of stiff white paper and stick a muslin strip down the outside of the fold, place this muslin-strengthened paper round the endpapers, and sew muslin, endpapers and section—first make three marks on the outside fold, one at the centre and one each $\frac{1}{4}$ inch from top and bottom, sew from the inside, bringing the needle out through the middle mark, in at the top, down the centre of the book, out at the bottom mark, then in at the middle mark, tying the two ends of the thread round the long inside stitch, when dry, the stiff paper beyond the muslin hinge is cut off. The boards,

the same width as the book but $\frac{1}{4}$ inch longer, are added, the muslin hinge being stuck to the boards which are set $\frac{1}{8}$ inch in from the stitched edge, thus overlapping the other edges all round by $\frac{1}{8}$ inch. Mark the boards to show where the cloth for the back comes, put paste on the cloth and place the closed

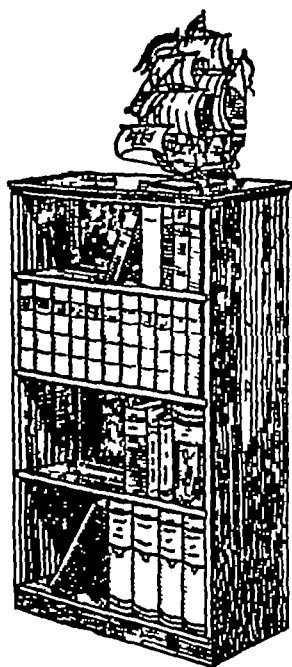


Binding a single-section book

book on it, folding the cloth round the muslin hinge and boards and rubbing well down. Open the book and turn the cloth over at the top and bottom, between the muslin hinge and the endpapers. Put sheets of wastepaper between the boards and endpapers, and keep the book pressed until quite dry. Take the coloured cover papers, put each board on the paper so that the paper overlaps $\frac{1}{8}$ inch on the cloth back and draw a pencil line all round it adding an extra $\frac{1}{8}$ -inch strip on three sides of your measurements to allow the coloured paper to be turned over the three outside edges of the boards. Paste each piece of paper, after cutting to size, place each board up to the pencil marks, turn the edges of the coloured paper over the edges of the board, cutting the corners where necessary,

and press down until dry Trim the endpapers so that they come $\frac{1}{8}$ inch inside the edges of the covers all round, paste the endpaper next to one cover down on to the cover to hide the muslin hinge and turned-over edges of the cover paper, do the same for the other cover. Place thick paper between each stuck-down endpaper and the free one, and dry under pressure

BOOKCASE. In the article on BOOKS FOR BOYS AND GIRLS, you will learn of some of the best books for you to read When you start to have books of your own you will need a place to keep them in, and the illustration shows a very simple bookcase made from straight pieces of wood The shelves fit into grooves $\frac{1}{8}$ inch deep



Easy to make

cut in the sides mark the position of each groove by pencil lines, saw $\frac{1}{8}$ inch deep along these lines, then chisel out the wood in between Glue the shelves into the grooves nail all the pieces into position from outside, driving the nail heads well down and filling in the tiny holes with a wood-filler If it is decided to fit a back to the bookcase several small pieces of wood can be used When the bookcase is assembled it can be stained and varnished See also WOODWORK

BOOK-KEEPING is a methodical way of keeping business accounts Two systems of book-keeping are in use—Single Entry and Double Entry Single Entry is usually used by small businesses In this system only personal accounts are shown, and the transactions are entered once only It has the great advantage of simplicity and gives little trouble But it is not sufficiently thorough For the check against fraud or against errors is not complete, nor does it show which department in the business is making profit or loss so that a profitable department may be retained whilst an unprofitable one is closed down Three main books are needed (1) the Day Book in which purchases and sales are recorded, (2) the Cash Book in which cash transactions are recorded, (3) the Ledger in which accounts are opened for each person to whom goods are sold and from whom goods are bought

Double Entry is more clear and detailed The basis of Double Entry is that every debtor (Dr) must have a corresponding creditor (Cr), for every buyer implies a corresponding seller In practice the contraction Dr is used for Debtor or Debit, and Cr for Creditor or Credit If A buys goods from B, then in the Ledger, A must give B credit for their value, i.e. Cr B, and as the goods are received, the goods account must be charged with their value, i.e. Dr Goods The account or person receiving is always debited The account or person parting with anything is always credited So a person is always Debtor for what he gets and Creditor for what he parts with If the accounts are well kept then the totals of credit and debits should always be equal in the Ledger The main books needed for Double Entry are. (1) the Day Book or

Sales Book in which sales are entered, (2) the Invoice or Purchase Book that records the goods bought, (3) the Cash Book in which all cash and cheques are entered, (4) the Ledger, the most important book in book-keeping—it is not a book of original entry, but to it the entries in the other books are posted or recorded, and here all the recorded transactions are classified, (5) the Journal for opening and closing accounts, and transfers from one ledger account to another. Subsidiary books are kept to give more detailed information, e.g. a Wages Book and a Petty Cash Book.

BOOK OF COMMON PRAYER. See PRAYER BOOK

BOOKS FOR BOYS AND GIRLS. One of the best and most profitable hobbies that anyone can have is reading books. Visit the Public Library and find out what books they have on their shelves.

The greater part of the shelves will be covered with story books. Whenever you read a book that you like, it is a good plan to make a note of the author, and see if there are any other books by the same writer. Reading stories of people who lived long ago is a good way of learning history, while stories about people in other parts of the world will help you with your geography.

Here is a list of authors who have always proved popular among young readers, with some of their best-known books. BALLANTYNE, a writer who tells of boys having strange adventures in remote parts of the world. *Coral Island*, Blackmore, *Lorna Doone*, a stirring historical romance, Enid Blyton, prolific writer of books for the young, John Buchan, straightforward adventure and historical stories of very high excellence. *Prester John*, *Thirty-Nine Steps*, Hylton Cleaver,

school stories *Captains of Harley*, Desmond Coke, school stories *House Prefect*, Richmal Crompton, the *William* books, stories of a mischievous boy, DEFOE *Robinson*

Crusoe, a great classic, Conan DOYLE, who created the famous detective, Sherlock Holmes, Fenn, adventure and historical stories

Cutlass and Cudgel, Henty,

historical tales of great merit. *In the Reign of Terror*, Hughes *Tom Brown's Schooldays*, still a favourite, Johns, adventures about his famous flyer—the *Biggles* books, Kingston, historical stories *From Powder Monkey to Admiral*, *Three Midshipmen*, KIPLING, tales of India, the sea and the jungle *Kim*, *The Jungle Books*, *Just So Stories*, Lofting, writer for young children *Dr Doolittle* books, Marryat, sea stories *Masterman Ready*, Milne *Winnie the Pooh*, Grahame *The Golden Age* and *Wind in the Willows*, Reed, school stories *Fifth Form at St Dominic's*, Sewell *Black Beauty*, a story of a horse, STEVENSON, historical fiction, including one of the finest boys' stories ever written *Treasure Island*, Herbert Strang, adventure and historical *Barclay of the Gudes*, Mark Twain, an American writer about American boys *Tom Sawyer*, *Huckleberry Finn*, Jules Verne, scientific adventure stories written many years ago when what he described was considered fantastic—it is now interesting to see how many of his inventions have come true, Westerman, adventure stories *Under the White Ensign*, Wyss, *Swiss Family Robinson*, the story of a shipwrecked family. Special writers of stories for



girls are Angela Brazil, Brenda Girvin, Amy Le Feuvre, E Nesbit, Kathleen Rhodes, May Wynne

BORACIC POWDER, or Boric Acid, is a white crystalline powder used as a mild antiseptic dressing for wet wounds

BORAX is a white powder used as a FLUX in welding in order to provide clean metal surfaces Its antiseptic properties are used in surgery and food preservation

BORNEO. See EAST INDIES

BOROUGH COUNCIL. See TOWN OR BOROUGH COUNCILS

BORSTAL, an establishment in Kent where experiments were carried out on young offenders against the law, to reform their characters in favourable conditions and surroundings rather than punish them The system has proved successful and today there are many Borstal institutions throughout the country

BOTANY is the study of plants, including their structure, life histories and relationships, how they grow, breathe, feed and reproduce

BOWLS is a game played with wooden bowls on a smooth grass green which is divided into strips 18 to 21 feet in width, called rinks Each bowl is $4\frac{1}{2}$ to $5\frac{1}{4}$ inches in diameter, weighs not more than $3\frac{1}{2}$ pounds, and has a certain amount of bias so that it does not travel in a straight line but in a curve the bias used to be obtained by inserting a piece of lead on one side, but is now more usually got by making one side of the bowl bulge more than the other A small white unbiased ball, called the jack, is first rolled at least 25 yards along the green, then each player in turn, standing on a mat, bowls, trying to get his bowl as near as possible to the jack When all the players have bowled their bowls, usually four in number but sometimes less, the umpire decides

which is the nearest. Then the jack is rolled to the other end of the rink and the struggle for the second "end" begins There are twenty-one "ends" to a game

There are other methods of playing the game in which points are scored, and on crown greens the ground itself slopes gently away from the centre to the sides

BOXING is fighting between two opponents with the fists encased in padded gloves Organized boxing follows Queensberry rules, named after the Marquess of Queensberry who helped to draw them up Boxers are classed according to their weight and they fight men of their own class The heaviest are heavy-weights, then come light-heavy or cruiser-weights, middle-weights, welter - weights, light - weights, feather-weights; bantam-weights, and fly-weights A match takes place in a ring, a roped square surrounding a canvas floor, and is controlled by a referee The fight is divided into rounds of three minutes each, with a minute's rest in between Seconds attend to the boxers between rounds A boxer may win by knocking his opponent out, i e hitting him so hard that he cannot rise off the ground within ten seconds, he may win on a foul if he is struck foully, e g below the belt, butted with the head, or when he is on the floor, he may win on points if the judges decide that he has struck more telling blows than his opponent Sometimes a boxer is receiving such punishment that his seconds throw in the towel, thereby signalling defeat, to save the boxer further punishment

BRAHMS, Johannes (1833-1897), was a great German composer who, while working mainly on the lines of the great classical masters and casting his works in sonata FORM, yet infused them with the romantic



Boxing helps to keep you alert, agile and fit

spirit which had been brought to music by many composers See **ROMANTIC SCHOOL**

BRaille is a form of printing which enables blind people to read, by touching with their finger-tips arrangements of raised dots representing letters, numbers and other symbols

BRASS is an **ALLOY** containing 50 to 70 per cent copper The rest is mostly zinc with a little lead Brasses of a high proportion of copper are soft and easily worked

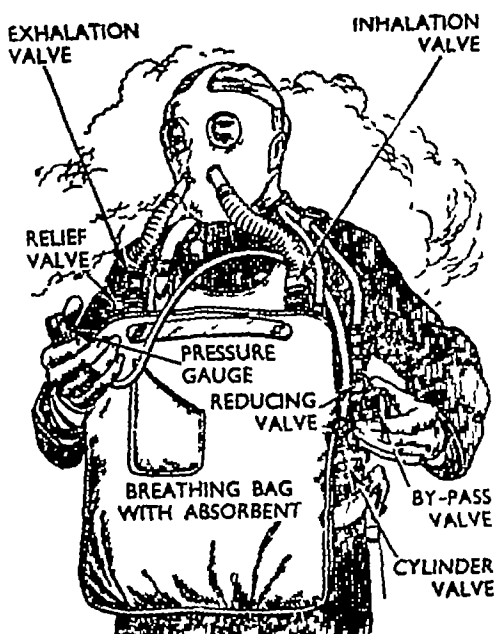
BRASSICA is the name given to plants of the cabbage family Well known examples are broccoli, brussels sprouts, cauliflower and kale

BRASS WIND INSTRUMENTS, in the **ORCHESTRA**, are **TRUMPETS**, **HORNS**, **TROMBONES** and **TUBAS** These are still called "brass" to distinguish them from the woodwind instruments, though they may be made of other metals

BRAZIL is the largest country in South America Primitive Indians live in the forests around the Amazon, where Brazil nuts and rubber are collected for export

Gold and diamonds are mined in the east, coffee and cotton are grown in the south, and sugar in the north The chief exports are coffee, cotton and cotton goods, cocoa, hides and skins, tobacco, manganese, and rubber The main towns are Rio de Janeiro, the capital, the rubber port of Belem, Recife, and São Paulo and the port of Santos in the coffee-growing region Most of the people live around the southern ports and in the mining region See map of **SOUTH AMERICA**

BREATHING APPARATUS allows men to work in a poisoned atmosphere or one deficient in oxygen A typical set has a steel cylinder containing oxygen at high pressure strapped to the wearer's back When the cylinder valve is opened oxygen passes through the reducing valve at reduced pressure into one side of the breathing bag, this is divided down the middle except at the bottom where there is a layer of chemical absorbent right across the bag The oxygen is breathed in from the bag through



Breathing apparatus in use

the inhalation valve. The exhaled breath, consisting of unused oxygen mixed with carbon dioxide, is breathed back through the exhalation valve into the other side of the breathing bag, it then passes through the chemical absorbent at the bottom the carbon dioxide is absorbed but the oxygen passes through the absorbent into the first side of the bag, where it mixes with fresh oxygen from the cylinder. It is then breathed in again through the inhalation valve. By means of a pressure gauge kept in a pocket on the bag the wearer of the set can at any time see how much oxygen he has left, a by-pass valve allows a rapid supply of oxygen to the bag when the set is first put on or when the wearer needs more oxygen during operations; and a relief valve permits the wearer to release some of the contents of the breathing bag if it gets over-inflated.

Other types of breathing apparatus are used to allow men to escape from submarines, or for helping people suffering from lung trouble

BRIDGE. The oldest type is the *span or girder bridge* supported on two or more piers. As the bridge was originally of timber, the span was limited by the strength of wood, with steel girders much greater spans are possible, and many simple bridges are of this type. When the *ARCH* was discovered, not only could larger spans be used but much heavier loads could be carried. Masonry arches, however, become very heavy in long spans, and modern arch bridges, of which the Sydney Harbour Bridge in Australia is the best example, are made of steel.

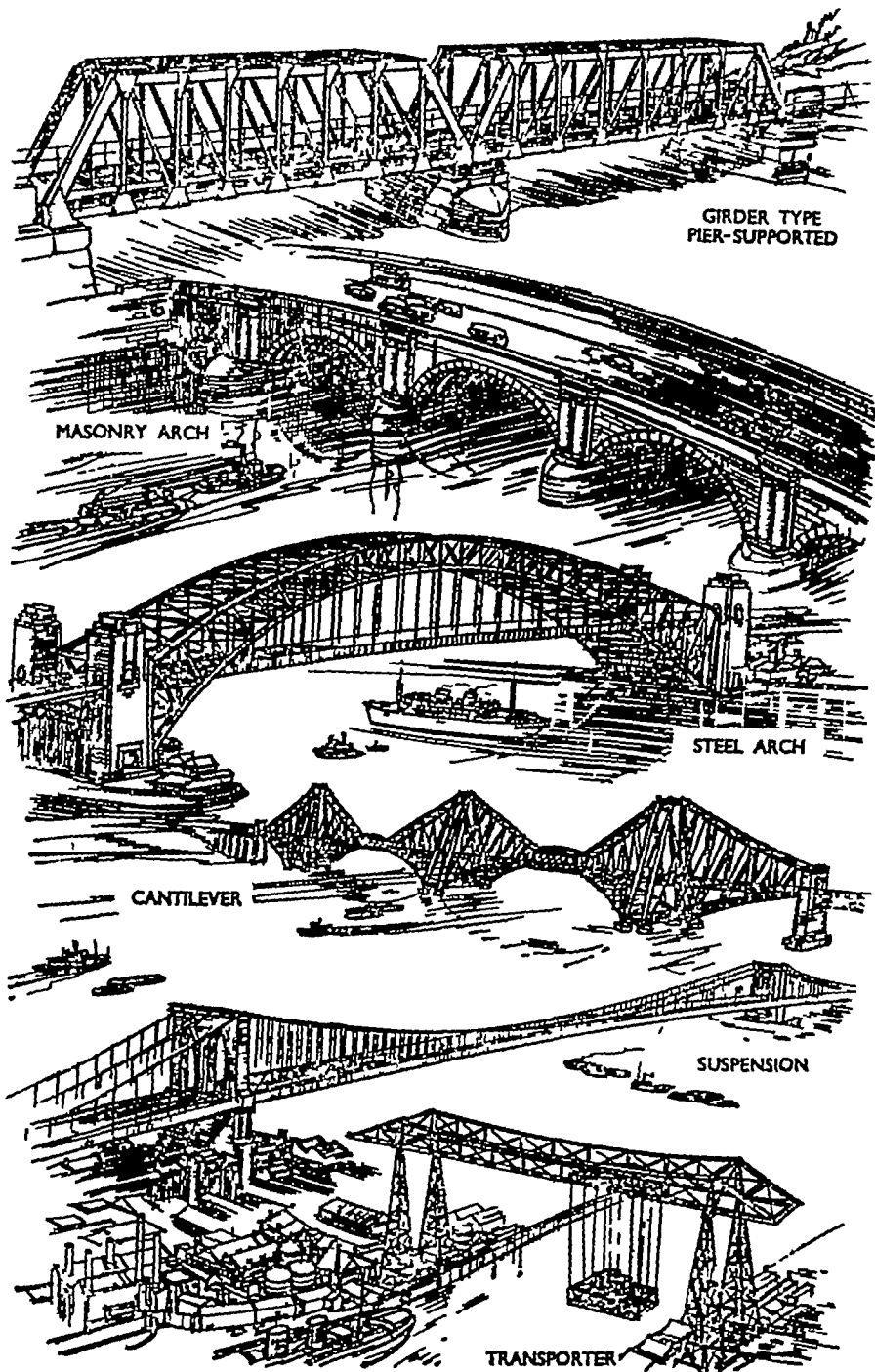
The *cantilever* bridge is rather like a man with both arms outstretched and a weight in each hand. The Forth Bridge in Scotland is of this type. Between each pair of cantilevers may be placed a light girder bridge. The cantilever gives a long span and good headroom.

Then there is the *suspension* bridge, in which the roadway is suspended from a continuous cable which, held by high towers on each bank, runs completely across a river without any intermediate support. Given modern materials very long spans, e.g. Hudson Bridge, New York, are possible, giving good headroom for shipping and no obstructions in the way.

A *transporter* bridge is supported at both ends on pylons, with a travelling cradle on which passengers and vehicles are carried across.

BRITISH COMMONWEALTH OF NATIONS. This is the name now used instead of *BRITISH EMPIRE* as it better expresses the fact of a free and equal partnership of several nations bound together by allegiance to the King. The various parts may be divided into four groups—

(1) The self-governing nations—Britain, Dominion of Canada, Union of South Africa, Common-



Here are some of the principal types of bridge to be found today

wealth of Australia, Dominion of New Zealand, Southern Rhodesia, India, Pakistan and Ceylon

(2) Crown Colonies and Protectorates having various degrees of self-government, with a Governor appointed by the Colonial Office at the head of affairs

(3) MANDATED TERRITORIES

(4) Condominium, where control is shared with another power, e.g. the Anglo-Egyptian Sudan

By the Statute of Westminster (1931) the dominions were declared "equal in status" to Great Britain—free nations, united by a common loyalty to the British Crown

BRITISH EMPIRE is the former name of the **BRITISH COMMONWEALTH OF NATIONS**, and is a term still used by some writers for those parts of the world associated with Britain but not of **DOMINION** status

BRITISH GUIANA. See **GUIANAS**

BRITISH HONDURAS is a British Crown Colony in Central America. The capital is Belize. See map of **CENTRAL AMERICA**

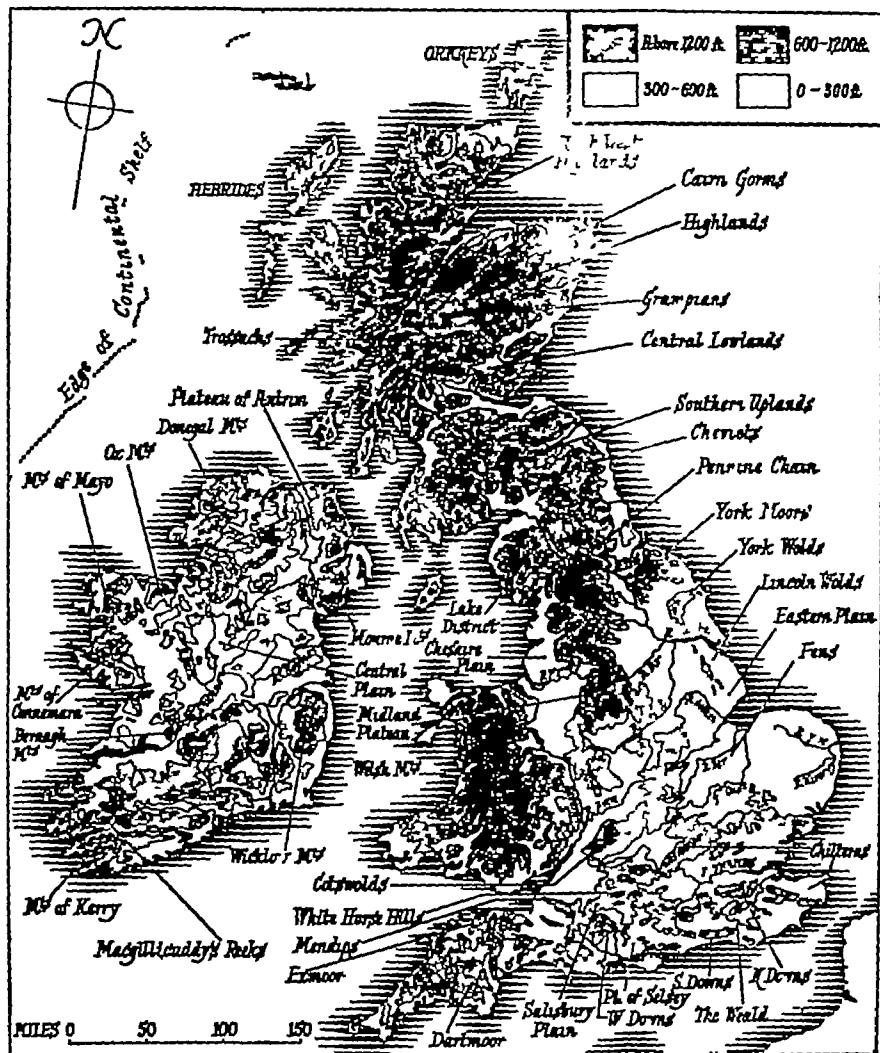
BRITISH ISLES, an archipelago consisting of two large islands, Great Britain (England, Scotland and Wales), and Ireland, and about 5,000 small islands. The islands are parts of the continental shelf and were once joined to Europe. **IRELAND** is dealt with in a separate entry. To the north and west of Great Britain are old, hard rocks which stand out as mountains and moorlands, and to the south and east low hills and broad valleys. The deep soils of the lowlands provide good farming country, but in the highland areas sheep farming and quarrying are often the sole means of livelihood. The **CLIMATE** is temperate, warmer in the south in summer, and in the west in winter owing to the prevailing westerly winds, which also cause

much heavier rainfall in the west. British weather is noted for its variations, which are due to the constant passing of high and low pressure systems. See **ATMOSPHERE**.

Agriculture has been for the last century less important than industry, and the country depends largely on imports for its food supply, but some mixed farming is carried on in most of the lowland areas, and certain areas specialize in particular crops or animals. East Anglia is suitable for wheat and barley, Kent grows hops and orchard fruits (also grown in the west Midlands), dairy cattle are reared in Devon and Cornwall, beef cattle in the Midlands, and sheep and horses in the western moorlands

Coalmining, carried on in South Wales, the northern counties and Scotland, is one of the leading industries, and much coal is normally exported. Iron ore is also mined, and china clay in Cornwall. The home food supply is augmented by fish, which is especially abundant in the fairly warm waters of the North Sea. Most of the important fishing ports, such as Aberdeen, Grimsby, Hull and Yarmouth, are on the east coast, where much fish, especially herring, is cured

Manufacturing tends to concentrate near the coalfields, though many of the new industries are in the south, where electricity is more plentiful, especially round London. Iron and steel are manufactured at Middlesbrough, Birmingham, Sheffield and the Staffordshire Black Country, **TINPLATE** in South Wales, woollen goods in Yorkshire, and cotton in the damp climate of Lancashire, chinaware in North Staffordshire, jute at Dundee and shipbuilding on the Tyne, Clyde and Mersey rivers. Clothing, rayon, radio sets and confectionery are produced in the Midlands and



Map of the British Isles showing many of the chief hills and rivers

around London London is the greatest factory city, the chief port and capital of the British Isles and of the BRITISH COMMONWEALTH It is also a great commerical city, and one of the greatest financial centres in the world Greater London, which includes the suburbs, covers 700 square miles, and contains a fifth of the total population of England The chief ports are London, Liverpool, Hull, Glasgow, Southampton, Bristol and Cardiff

See also entries on ENGLAND IRELAND, ISLE OF MAN, SCOTLAND and WALES

BRITONS, ANCIENT, the name given to the people living in Britain when the Romans came to the island Most of them belonged to the Celtic race, and were akin to the Gauls who settled in France One branch of the Celts, known as the Gaels, occupied the north of Britain and Ireland, and were the ancestors of the Highlanders and

the Irish The Britons occupied the south of Britain, and since the Anglo-Saxon invasion their descendants have lived in Wales

By the time of Caesar's visits (55-54 B C), many of the Britons had become more or less civilized They had farms and grew corn, they could spin wool and weave cloth They mined for iron, tin and gold, and made weapons, armour and ornaments of metal They made boats of wicker-work covered with skins, and moved by a paddle these boats are called coracles The Britons traded with northern Gaul, and used gold coins and iron bars as money London was a port even before the Romans came

The Britons were divided into a number of tribes or clans, each with its chief The tribes were often at war, they used horses and chariots, spears and darts The warriors carried shields of metal, ornamented with enamel

The Druids, as the priests of the Britons were called, were more feared than any war chief They were the judges, law-givers and teachers They were famed for their magic arts, and taught that certain plants, such as the mistletoe, were sacred Human sacrifices were offered before a tribe went to war See also ROMAN BRITAIN

BROADCASTING See WIRELESS

BROMIDE is a salt formed by combining the element bromine with another Silver bromide, sensitive to light, is used in photographic paper, and potassium bromide is used as a sleep-inducing drug

BRONTES, THE, were three remarkable sisters, Charlotte (1816-1855), Emily (1818-1848) and Anne (1820-1849), daughters of the Vicar of Haworth, Yorkshire In an age when most women were only housewives, they took masculine pen

names and wrote a number of novels which have given them a permanent place in literature In 1842 Charlotte and Emily went to a school in Brussels to acquire languages, as they wished later to open a school of their own Charlotte's *Villette* contains much material acquired at this time Her earlier books were *Jane Eyre* and *Shirley*

In 1844 Charlotte was back in Haworth, a few years later, however, tragedy came upon the family, her two sisters and brother dying within a year In 1854 Charlotte married her father's curate, but herself died soon after

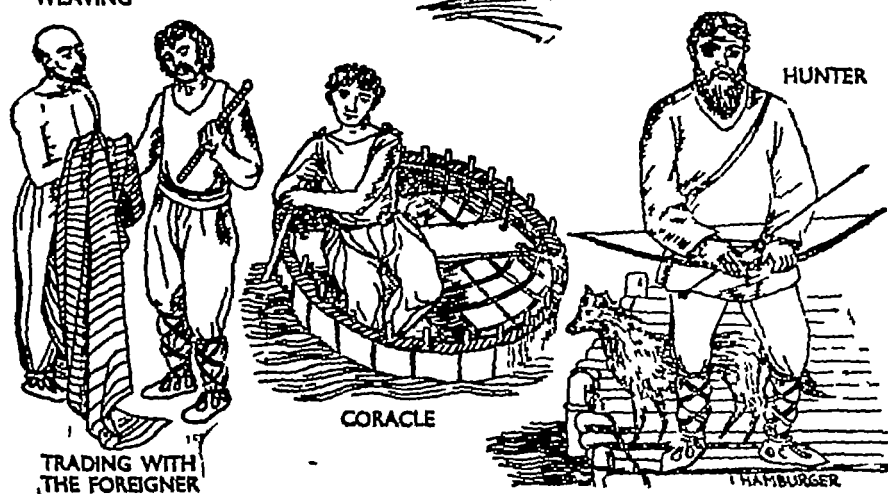
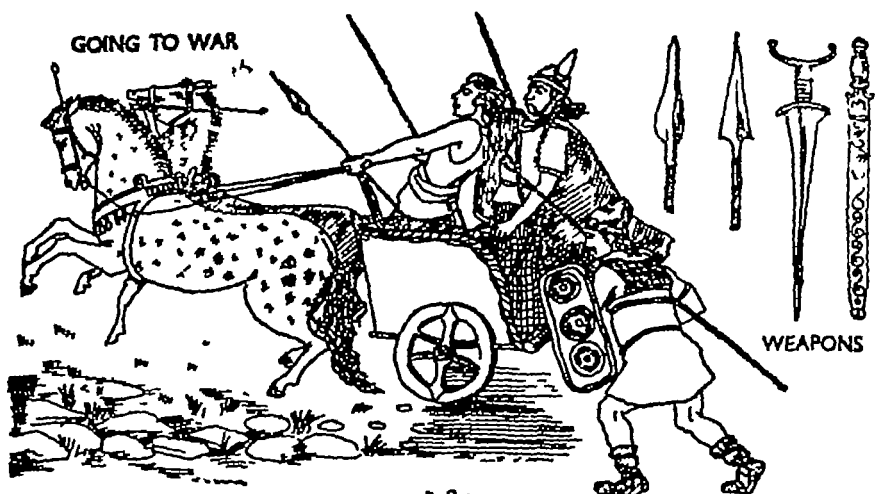
Emily was, perhaps, the most remarkable of the three At her best she was a fine poet, and her *Wuthering Heights* is indeed a novel full of power and passion Anne wrote *Agnes Grey* and *The Tenant of Wildfell Hall*, which, though dull, has been called the first feminist novel, that is, a story devoted to advancing the cause of women

BRONZE is an ALLOY of copper and tin, the proportions of which vary widely The alloy is hard, yet melts easily Since copper and tin ore occur together, the alloy was originally made almost by accident, and was used extensively for weapons and armour before the days of reliable steel

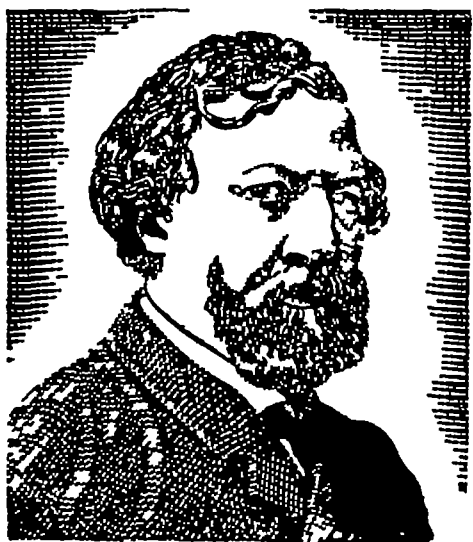
BROWNING, THE. Robert Browning (1812-1889) married in 1846 Elizabeth Barrett (1806-1861), an invalid whose home life was made miserable by a domineering father They were both poets and their marriage was very happy

Browning was the author of a very large number of poems, many being Italian in setting, and some, like *Paracelsus*, in dramatic form

He was supreme in the monologue—the type of poem in which one person, a real character, *thinks aloud* His best monologues are to



Scenes from the everyday life of the Ancient Britons



Robert Browning, poet

be found in his two collections *Men and Women* and *Dramatis Personae*. They include "Any Wife to Any Husband," "Fra Lippo Lippi," "Andrea del Sarto," and "Saul," among others.

Mrs Browning's best work was the series of sonnets inspired by her marriage, *Sonnets from the Portuguese* (1850), her best-known poem perhaps being "The Cry of the Children," arising from her indignation at the sufferings of young children who worked in factories.

BRUCE, Robert (1274-1329), a hero of Scottish history, was a descendant of the Scottish king, David I. When **EDWARD I** tried to unite Scotland with England, Robert Bruce at first played a double game, sometimes swearing fealty to Edward, sometimes fighting under William WALLACE, the Scottish patriot.

After the defeat and death of Wallace (1305), Bruce, who was living at the English court, began to plot with discontented Scots. He went to Scotland, and murdered his cousin, the Red Comyn, in the church at Dumfries. This deed made him the foe of Edward and

the Church, and a fugitive murderer. But with great daring he hurried to Scone, the crowning place of Scottish kings, where some of his friends crowned him. Edward had carried away the Scottish crown and coronation stone to London, so Bruce was crowned with a golden circlet torn from the head of one of the saintly images in the church.

For seven years, Bruce, although the crowned king of Scotland, was a fugitive, fleeing to the Highlands to escape the English, and there pursued by John of Lorne, a kinsman of Red Comyn. He suffered hardships and had narrow escapes, but was helped in all dangers by his own personal strength and by the faithfulness of a few friends, chief of whom was Sir James Douglas. At one time Bruce was forced to leave Scotland and take refuge on the lonely Rathlin Island off the Irish coast.

He returned to Scotland. Again he was hunted through the glens, but he began to win a few victories, and each victory brought him fresh followers. Once more the old King Edward I set out for Scotland, but he died at Burgh-on-Sands.

Now his chief foe was dead, Bruce was able to take castle after castle from the English until only Stirling remained in their hands. Then **EDWARD II** sent a huge army over the border, but Bruce met and defeated it at Bannockburn (1314), and so Scotland maintained its independence. In 1318, Bruce captured the border town of Berwick.

Bruce died at Cardross Castle on the Firth of Clyde (1329) after suffering for two years from leprosy. His body was buried in the Abbey of Dunfermline, but his heart was embalmed, enclosed in a casket and taken by his friend, the brave Lord Douglas, to be buried in the Holy



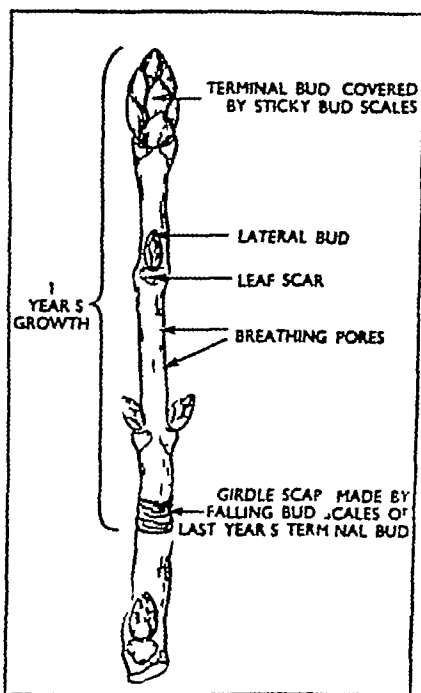
Douglas hurled forward the casket with Bruce's heart

Land—for Bruce had so desired it. But the heart never reached Jerusalem. Lord Douglas was slain in Spain in a battle against the Moors. During the fighting he flung the casket forward, crying, "On, on, brave heart! who never turned back from the foe!" The casket was recovered and the heart was buried in Melrose Abbey.

BUD Plants' leaves, flowers, and side branches grow from buds, within which the delicate young parts are protected while they develop. Flower buds are protected by sepals. The buds for the next year form in late summer and are covered by regularly arranged bud-scales. The terminal bud is at the tip of the twig. Lateral buds are arranged opposite one another in pairs, or in a spiral manner. Each lateral bud grows in the axil of a leaf, that is, between leaf base and twig.

BUDDHA, Gautama Siddhartha, was born in INDIA about 500 B.C. and is called the "Buddha," which means "the enlightened one." After a luxurious childhood he left home

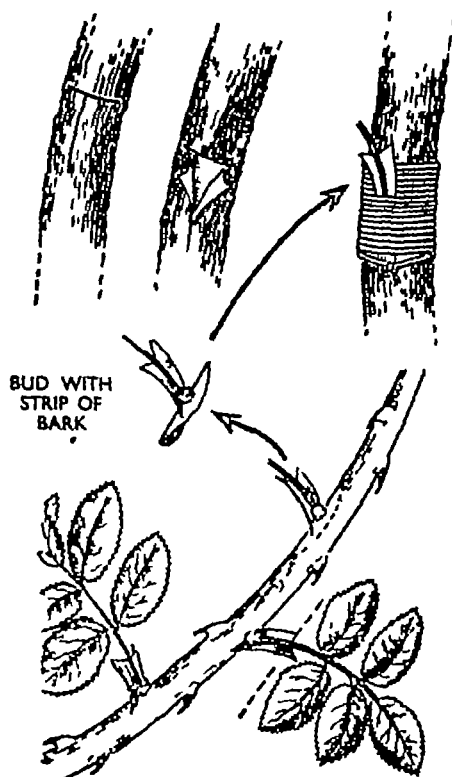
and spent years meditating in the jungle, then returned to preach a new way of living based on unselfishness, charity and good deeds.



Terminal and lateral buds

thus Nirvana, the perfection of knowledge, is reached Like HINDUISM, Buddhism preaches reincarnation—that every individual passes through many lives, sometimes, it may be, in the form of animals Buddhism died out in India, but is still found in surrounding countries.

BUDDING is a form of **GRAFTING**, used mostly with roses to put a new variety on to a more common type of rose-tree Instead of attaching a whole twig as in normal grafting, however, one bud only with a small piece of wood and bark attached is affixed to the stock It is inserted in a T-shaped cut previously made, and bound and waxed Evidence that the two are successfully united is produced by the swelling of the bud The operation, however, should only be carried out during the months of July and August

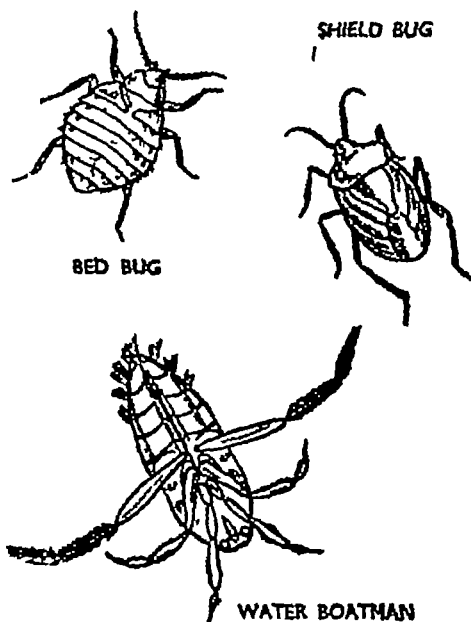


Slit bark then insert bud

BUDGERIGAR. See **CAGE BIRDS** and **PARROT**

BUFFALO. See **HOOFED MAMMALS**

BUG is a term sometimes applied (especially in America) to any **INSECT**, sometimes to one particular

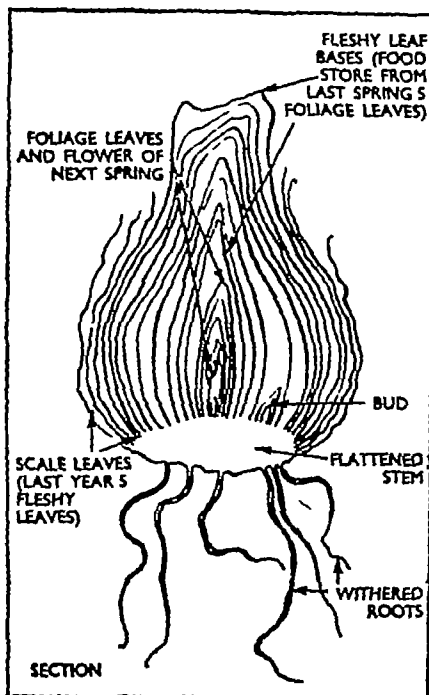


Three common kinds of bug

PARASITE, and correctly to an insect order in which all the members have mouth-parts adapted for piercing and sucking Some can fly, but none has a pupal stage Water-bugs include water boatmen and pond-skaters, plant-sucking forms include frog-hoppers (cuckoo-spit), greenfly and other harmful aphids, while the bloodsucking bugs and lice are **PARASITES**

BUGLE, a musical instrument of brass or copper, it has a very limited range of notes, but bugle bands are used by soldiers and boy scouts It is also used for giving signals. See page 405

BULB, a food-storing type of plant such as the daffodil, tulip, onion, etc A bulb is a special kind of **BUD** consisting of a flattened stem from which grow both roots and



Bulb with its food store

food-storing leaves, the latter providing a larder for the plant's growth and flowering in the spring.

Bulbs can be planted in pots or bowls indoors in a mixture of equal parts of leaf-mould, soil and silver sand. If there is no drainage hole in the bottom, fibre should be used. Too much water will rot bulbs. For the first four or five weeks they should be kept in the dark. Darkness encourages root growth and thus the roots become firmly established before the effect of the light begins to bring forth the shoot. Garden tulips should be dug up after they have flowered and re-planted again in the late summer or autumn. Daffodil and narcissus bulbs are generally left in the ground for at least three years.

BULGARIA is a semi-mountainous republic around the Balkan and Rhodope Mountains, with large plains to the north and on the Black

Sea coast. It is mainly an agricultural country, and grain, tobacco, sugar-beet, sunflower seed oil, grapes, prunes and attar of roses are the chief products. The capital is Sofia. See map of the BALKAN PENINSULA.

BUNYAN, John (1628-1688), son of a tinsmith, was born near Bedford, learned to read and write, and followed his father's trade. He fought on the Parliamentary side in the Civil War. See **CHARLES I**. His first wife turned his thoughts to religion and a friend sent him to the Bible, which he studied diligently.



Bunyan, preacher and writer

In 1653 he joined a Nonconformist church.

The RESTORATION of 1660 brought legal measures against Nonconformists, and Bunyan was sent to prison for preaching, where he remained till 1672. In prison he wrote *Grace Abounding to the Chief of Sinners*, a deeply religious autobiography. Freed, he was elected pastor of his church. But again he

was imprisoned, and in his six months in gaol he wrote part of *The Pilgrim's Progress* (completed by 1678), an ALLEGORY telling of the search of the soul for God in the guise of a difficult and adventurous journey. He wrote other books, but of all his works this book, because of its strong feeling and good story telling, is the accepted favourite with boys and girls of to-day.

BURKE, Edmund (1729-1797), was a Dubliner who entered Parliament, becoming one of its greatest Liberal orators. His political life was devoted to the freeing of the House of Commons from the control of GEORGE III and his friends, the improvement of relations with the American colonies (though he did not approve of their complete independence) and with Ireland (especially the removal of restricting laws from the Irish Catholics), the removal of the East India Company's control of Indian affairs, and the abolition of the slave trade. Some of his best speeches were made on American affairs, and he opened the case against Warren HASTINGS in 1788. In 1790 appeared his *Reflections on the French Revolution*, a movement which he denounced.

BURLESQUE, a comic imitation of a serious work, or the comic treatment of a dignified subject, or anything done for the purpose of amusing or deriding.

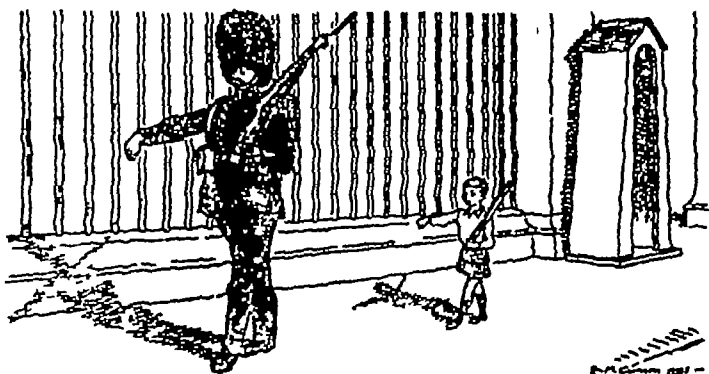
BURMA is a republic of south-east Asia. Much of the land is covered by deep jungle, but rice, oil and teak are ex-

ported. The Burma Road links Lashio with China. The chief towns are Rangoon, the capital, and Mandalay, an important road centre inland. The people are related to those of INDO-CHINA. See map of INDIA.

BURN. See **FIRST AID**.

BURNS, Robert (1759-1796), the son of a small farmer, himself worked as a farm labourer. From 1784 to 1788 he farmed with his brother and produced some of his best literary work, "The Cottar's Saturday Night," "To a Mouse," "To a Mountain Daisy." In 1786 he published his poems to earn passage money to Jamaica. As these brought him fame, he lived in Edinburgh for a time, very popular in society there. In 1788 he married Jean Armour and settled on a farm near Dumfries. In 1789 he took a position as exciseman, though his political sympathies nearly led to his dismissal in 1791.

In such a poem as "A Man's a Man for a' That" Burns expresses and perpetuates the democratic spirit of the Scots. His fame rests chiefly on his songs and love lyrics, some of which, like "The Banks of Doon," and "Comin' through the Rye," were set to folk tunes. Other songs include "Auld Lang Syne," "Mary Morison," and "John Anderson, My Jo," all very famous.



Burlesque, the comic imitation of a serious subject



INDIAN LEAF BUTTERFLIES, ONE WITH FOLDED WINGS



SEYCHELLES LEAF INSECT BLENDS WITH THE LEAVES



NILE ANGEL FISH MERGE WITH WATER PLANTS



PTARMIGAN'S COLORING MATCHES THE HILLSIDE

How Nature protects certain creatures from their enemies See CAMOUFLAGE



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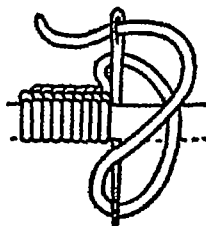
Robert Burns, Scotland's poet

BUTTERFLY and **MOTH** form the **INSECT** order *Lepidoptera*, the "Scale-winged," their wings being covered with minute scales, overlapping like roof tiles, so thin that they break up white light into its constituent colours. From the egg comes the larva or caterpillar, feeding on leaves or wood. In its next stage, the resting stage, it is a chrysalis or pupa often covered by a silken cocoon, which the caterpillar spins round itself. From this emerges the full-grown insect. It has no jaws like those of the caterpillar, but tubular mouthparts for sucking nectar, coiled like a watch spring. Moths have squat bodies, their antennae are feathery and pointed, whereas butterflies have clubbed antennae. Butterflies are on the whole more brilliantly coloured than moths, fly by day rather than night, and fold their wings vertically instead of horizontally.

Lepidoptera hibernate (sleep right through the winter) as caterpillars, chrysalises, occasionally as adult insects, such as peacock or

small tortoiseshell butterflies. Most can be reared in captivity if given the right food plant. The larvae of some, such as cabbage whites on cabbage and tortrix moths on oak trees, do much harm.

BUTTONHOLES are worked on double material. If the cloth is single, a piece of tape or material is secured at the back and the buttonhole worked through this double thickness. The length of a buttonhole should equal the width of the button plus $\frac{1}{4}$ of an inch to cut the buttonhole, mark the required length and position with two pins and crease this line. Fold the material through the centre and at right-angles to the creased line



Tailors' buttonhole stitch

snip with the scissors at the centre of the fold, open, and cut to the required length each side.

To work the buttonhole, slip the needle between the folds (for a 1-inch buttonhole use 1 yard of thread) and bring it out at the inner end of the buttonhole on the wrong side. Work a small **BACK STITCH** and pass the needle to the right side. Work tailors' buttonhole stitch along the sides and round the round end. Make several backstitches over the two end stitches, use buttonhole stitch over the back stitches at



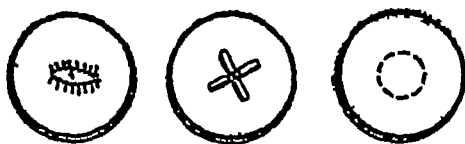
Working the buttonhole

right-angles to the slit. For a buttonhole with square ends, work both sides first. Fasten each end with two back stitches. Cover the back stitches with buttonhole stitching as before.

BUTTONHOLE STITCH is an edging stitch. The space between stitches should not be greater than the length of the stitch. For the method of working, see **BLANKET STITCH**.

BUTTONS, TO SEW ON. For pierced linen buttons, pearl buttons, and others similar, secure the cotton where the button is to be placed with **BACK STITCHES** on the right side. Then stitch several times through the garment and holes in the buttons. Finish by winding the cotton several times round the shank (i.e. the sewing threads) and bring the cotton to the wrong side, securing it with back stitches.

For unpierced linen buttons,



Sewing on unpierced buttons

secure the thread in the position the button is to occupy, and sew on by one of the methods shown.

BUZZER (or sounder). A current passes through an **ELECTROMAGNET**, which attracts an iron armature inside, and pulls a spring until the armature has moved enough to open the contacts. When this happens, the current through the electromagnet is stopped, and the armature, no longer attracted, is pulled back to its original position by the spring. But this closes the contacts, enabling the current again to pass and the whole process is repeated. The backwards and forwards movement takes place at a high speed, and so the vibrating armature gives out a buzzing sound. (See picture under **TELEGRAPHY**.) Buzzers are used chiefly for the production of audible signals in telegraphic transmission. See also **BELL (ELECTRIC)**.

BYRD, William (1543-1623), was one of the greatest and most versatile of the English composers of the time of Queen Elizabeth and James I. His church music contains masterpieces. He also wrote **MADRIGALS**, "apt for voices or viols," and was one of the earliest composers of keyboard music.

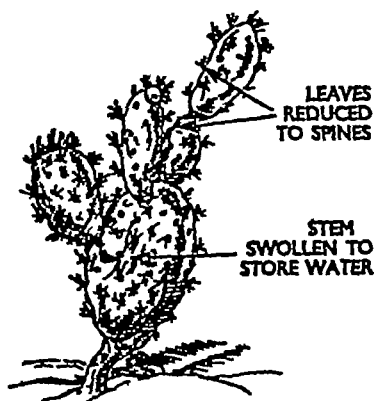
BYRON, George Gordon, Lord (1788-1824), the famous poet, was born lame and his childhood was unhappy. As a young man he travelled, Greece touching his imagination in its fight for independence from Turkish rule. In 1815 he married but soon quarrelled with his wife and left England. He lived in Switzerland and Italy, and records the beauty of these countries in his *Childe Harold*, Cantos III and IV. He died of fever while helping the Greek cause. Among his works are *The Prisoner of Chillon*, *Don Juan* and *The Vision of Judgment*.



Young Lord Byron



CACTUS, a member of a group of plants specially adapted to desert conditions. The leaves are reduced to spines, so that they do not give off the water which the swollen



Cactus adapted to the desert

stems store. Some bear large and brilliant flowers.

CADDIS-FLY, an order of INSECT in which the adult resembles a small moth or fly, while the larva lives in ponds or rivers. Each larva protects its delicate body by making itself a case of fragments of leaf, stick, stone or shells, according to its species.

CADENZA, literally a "cadence," it has now come to mean the opportunity given by the composer to the performer of a CONCERTO to show off his technical powers in a solo passage. In earlier days, performers were expected to extemporize the cadenza, but now composers generally write the notes to be played.

CAESAR, Gaius Julius (about 102-44 B C), the greatest of Roman generals and rulers, after an adventurous career was elected Dictator of ROME where he effected much to

the improvement of the city. As commander of the army he subdued Gaul, part of Britain and the whole of Italy, establishing the Roman tradition throughout much of Europe. He was murdered by Brutus and Cassius, two of his political opponents.

CAGE BIRDS. Canaries, budgerigars and parrots will live happily in small cages, but an aviary is much more fun, both for yourself and the birds. The best way is to build it along a south wall. At one end you must have a roosting shelter with a sloping roof, waterproofed with tarred felt. It must be draught-proof, well creosoted, and well limewashed inside twice a year.

Plant young trees and shrubs in pots sunk in the floor of your aviary. These can be renewed or taken out at intervals for a rest. Don't forget to arrange a number of perches and swings so that the birds can get



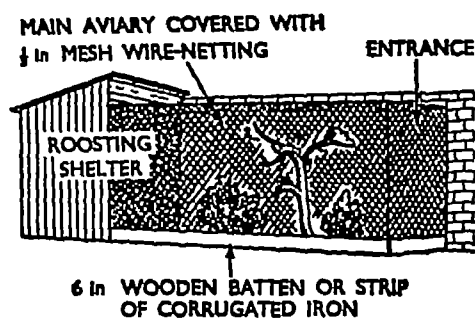
Julius Caesar, ruler of Rome

plenty of exercise Nesting boxes should be hung in quiet corners out of draughts and direct sunlight They should be liberally supplied with nesting material—dried moss, dried bents and grasses as well as “cow’s hair,” which is really doe’s hair. Have a drinking fountain constantly supplied with fresh, clean water and hang your seed boxes and food trays where mice cannot get at them A piece of cuttlefish bone hung near a perch is also popular Remember to give your birds a shallow dish of water, changed daily, to bathe in

Canaries and other Finches

should be fed on a mixture of three parts canary seed, one part linseed and two parts summer rape, with half a teaspoonful of patent egg food (per bird) once a week, together with plenty of fresh greenstuff—lettuce, dandelion, groundsel, etc., and wild seeds—plantain, teasel, grass-heads, etc., in season

Tanagers should be fed on equal quantities of powdered biscuit, ants’ eggs and dried flies, just



Aviary for cage birds

moistened with milk and sugar and ripe, sweet fruit and live insects

Budgerigars and Waxbills eat much the same food as canaries,



Cage birds make affectionate pets

though they need additional live food such as meal-worms, flies and spiders

Parrots are strict vegetarians, as a rule, and should be given parrot seed mixture, sunflower seeds, ripe fruit and sometimes biscuits and bread—but not buttered bread They need plenty of gritty sand and a chunk of hard wood to keep their beaks in condition.

Jackdaws prefer being given the run of the house and yard though they can be happy in an aviary if it is large enough They will flourish on table scraps and greens, but they should have a proper meal of shredded meat or liver every two or three days

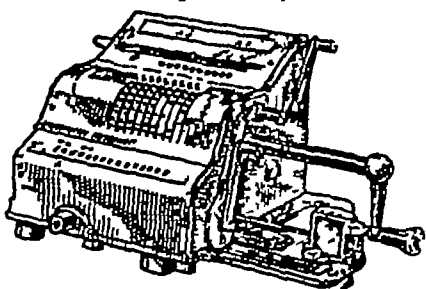
Never keep a wild bird in a cage. It is stupid and cruel, and there are plenty of domesticated breeds that make tame and affectionate pets.

CAKE-MAKING. The chief rules for making and baking cakes are. (1) The oven should be heating while the cake is being mixed (2) Tins should be greased, and fruit and other ingredients prepared before the actual making begins

(3) For shortening the cake, lard or dripping is used for very plain cakes, butter, margarine, or butter and margarine mixed, for others (4) For very plain cakes the fat is rubbed into the flour as for pastry For richer cakes the fat and sugar are creamed together with a wooden spoon For sponge cakes the eggs and sugar are beaten until creamy in a basin which has been warmed with hot water and then dried Occasionally the butter or margarine is melted before being added The first mixing is important and must not be scamped (5) The consistency of a large cake should be such that the mixture will drop easily from a spoon, for small cakes it should be stiffer, and for rock cakes it should be stiff enough to form little heaps on the baking tin (6) Large cakes are baked in a moderately hot oven, allowing one hour per pound, small cakes in a moderately hot oven for twenty-five to thirty minutes, rock cakes in a hot oven for twenty to twenty-five minutes (7) A cake is done when it

is brown and firm, and when a skewer put into the mixture comes out clean

CALCULATING MACHINES carry out such operations as addition and multiplication, subtraction



Calculating machine for the office

and division mechanically by a system of gear wheels The result appears in a window on the machine or is automatically printed on paper

Very elaborate devices, some of which are worked by electricity, have been constructed by scientists for use in the laboratory, to solve equations too difficult for the human mind to grapple with

CALCULUS. See **MATHEMATICS**

CALORIE See **HEAT**

CALVIN, Jean (1509-1564), a leader of the REFORMATION, was a Frenchman who lived in Geneva from 1536 His faith was that God is the source of all good, the first man was made in His image, and because Adam transgressed, sin attaches to every man The doctrine of Calvinism insists upon personal, individual salvation, demanding that men shall know what is the will of God, and shall carry it out Only the qualities of righteousness, integrity and purity are acceptable to Him Calvinism is a stern form of religion, but won

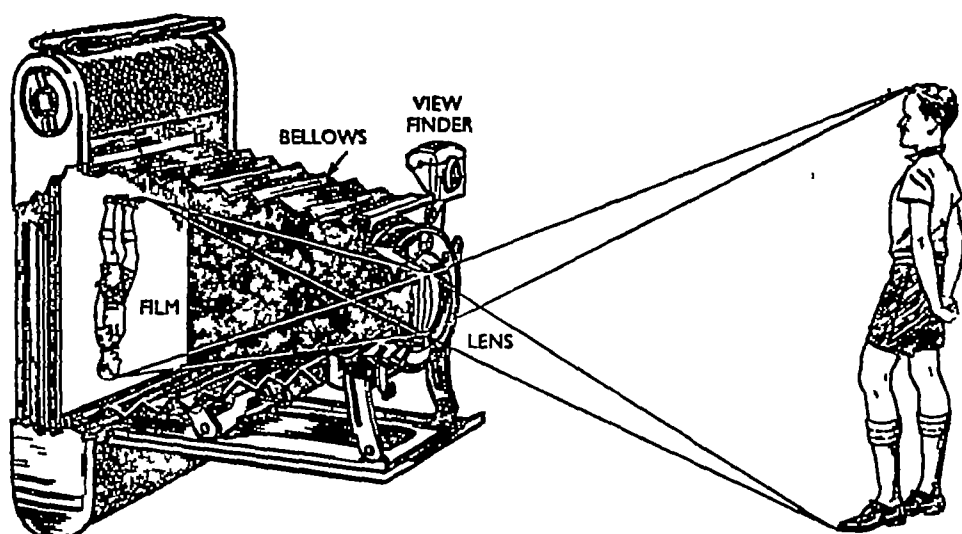


The cake should be placed in the centre of the oven

many adherents, principally in Holland and Scotland

CAMEL See DOMESTIC ANIMALS, HOOFED MAMMALS and TRANSPORT

the British section forming part of NIGERIA, and the French section forming part of FRENCH EQUATORIAL AFRICA See map of AFRICA



Parts of a camera—note how the image is reversed

CAMERA, an apparatus for taking photographs. It consists of a light-proof box with a **LENS** at one end and a place for a plate or film with a surface sensitive to light at the other end. The distance of the sensitive surface from the lens is so arranged that the image of, say, a person falls just on the sensitive surface. In many cameras this is done by having the box of variable length with "bellows" sides. To control the length of time that the light is allowed to fall on the sensitive surface, a shutter is placed over the lens; this opens for exact periods of time varying from a thousandth of a second to two seconds. A "stop" which cuts down the exposed area of the lens is also fitted to allow varying amounts of light to enter. In the viewfinder can be seen what is before the lens. See **PHOTOGRAPHY**.

CAMEROONS, a former German West African territory now under French and British **MANDATE**,

CAMOUFLAGE. Many animals have markings or structures which make them either resemble another animal or plant, or render them almost indistinguishable from their background. A leopard may be practically invisible against the dappled sunlight of a forest. Some caterpillars look almost exactly like twigs on a branch, some butterflies like leaves, while chameleons and frogs may change colour according to their surroundings. Some fishes and birds blend with their backgrounds. Many northern animals, such as the Arctic fox, hare and weasel, acquire white fur in the winter snows. The stoat changes its coat in winter and its fur is then known as ermine. See also **MIMICRY**.

Camouflage is also the treatment of the surface of an object, building, vehicle or ship with paint or other material such as netting so that an observer is deceived as to the true shape, position or movement of the

object It is mainly used in wartime with a view to hiding ships, guns and men, and disguising factories so that they are invisible from the air

CAMPING out in the open can be combined with **HIKING** and **CYCLING**, but where the camper has to carry his kit with him during the day it is essential that such kit should be as light as possible. Certain shops specialize in articles for the camper and simple light-weight tents with telescopic poles can be obtained. You also want a light oiled fabric groundsheet to keep out the damp, and a sleeping bag. For cooking, a primus stove will replace a fire, you also need aluminium cooking utensils, plastic cups and plates, knife, fork and spoons. Then you will want a canvas bucket for getting fresh water from a house (the safest plan), a wash basin, and a torch for the tent, in addition to the other articles necessary to any hiker or cyclist.

Pitch your tent on a dry sheltered spot, the opening facing away from

the wind. Keep the site tidy, remembering that it is your duty to leave it as clean as you found it. In wet weather remember not to touch the outside fabric of the tent, otherwise it may let in water at that point. It is best if the site is near (but *not* under) trees, from which you can obtain really dry sticks for lighting your fire, which may have to be sheltered by a windbreak. See that the fire cannot set light to grass or bracken. Cooking can be done with the pots on two bricks or hanging from fresh green sticks which won't burn. Racks for holding utensils and articles can be improvised from sticks and branches.

Campers staying for a considerable period at any one site should use a stronger and heavier tent, more and heavier kit including a stout rubber groundsheet and a special box for food, and should dig a proper latrine and a grease pit for muck and rubbish.

There is an organization for campers which provides members with lists of suitable sites together



It is more fun when the camp is kept orderly and tidy

with much other useful information

Camping out affords an excellent opportunity to get to know nature, and some previous knowledge of plant and animal life can add enormously to one's enjoyment of a camping holiday

CANADA is a self-governing dominion of the **BRITISH COMMONWEALTH**, containing most of the northern part of **NORTH AMERICA**. The north stretches into the Arctic Circle. The Rocky Mountains of the west slope to the great central prairies, which have the Great Lakes on their southern border, in the north-east is the Canadian Shield, a barren area of old hard rock with poor soil. The country is almost divided by Hudson Bay, which stretches from the Arctic Circle down to Ontario. The people are mostly of British descent, with a large French-speaking population in Quebec Province. The Canadian National and Canadian Pacific Railways link the east and west coasts.

The *Maritime Provinces* the chief products are timber from the forested uplands of New Brunswick, apples from Nova Scotia and dairy produce from Prince Edward Island. Halifax is an important ice-free port.

St Lawrence Valley and Lake Peninsula Quebec Province, on the banks of the St Lawrence, is a region of lumbering, dairy farming and fruit growing. It has a large paper industry. Quebec, the capital, is an important port and railway centre, and Montreal, the largest town, is an industrial area and a centre of the great Canadian grain trade.

Ontario, on the Great Lakes, is the chief manufacturing area of Canada. Gold, silver, and nickel are mined. On Lake Ontario is Toronto, capital of the Province, and Ottawa, capital of the Dominion.

PRAIRIES, vast grasslands, in the provinces of Alberta, Saskatchewan, and Manitoba, grow huge quantities of grain. In the ranching country of Alberta cattle and sheep are reared. Winnipeg is a great railway centre and wheat market. The capitals are Edmonton, Regina and Winnipeg.

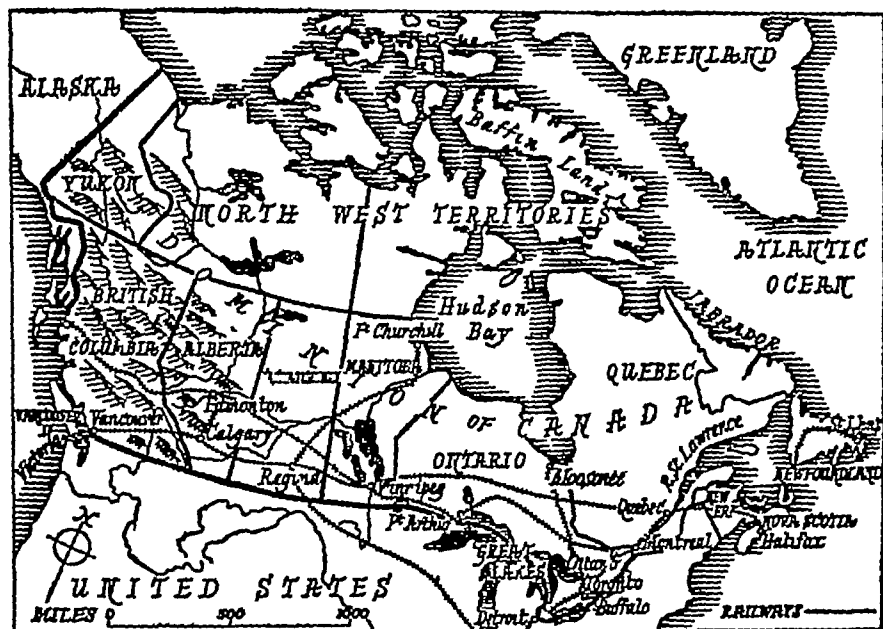
The *Western Highlands* contain British Columbia and part of Alberta. Dense forests clothe the mountain slopes, but dairy farming and fruit growing are carried on in the southern valleys, and salmon fishing in the Fraser River. Elsewhere mining and lumbering are the chief occupations. The chief towns are Vancouver, and Victoria, capital of British Columbia.

North-West Territories are a barren region of **TUNDRA** reaching into the Arctic. Some gold-mining is carried on in the Yukon area, but elsewhere Eskimos are the sole inhabitants.

Although the population of the dominion is only 11½ million, Canada is now one of the world's greatest manufacturing countries, and largest exporter of wheat, paper, nickel and asbestos.

History The coast of Canada was sighted by John Cabot in 1497, but the first European to explore the great River St Lawrence was a Frenchman, Jacques Cartier (1534). Early in the 17th century, French settlements were made in Acadia (now the Maritime Provinces) and at Quebec and Montreal on the St Lawrence. In 1670, the Hudson's Bay Company was founded by Prince Rupert, cousin of Charles II, and English trading posts were set up around Hudson Bay. Rivalry between English and French fur traders was part of the struggle between Britain and France which lasted until the 18th century.

During that time the two countries were almost continually at



Map of Canada, showing the provinces, lakes and mountains

war In 1713, by the Treaty of Utrecht, Acadia was ceded to Britain, and renamed Nova Scotia (New Scotland), and Halifax was founded in 1749. The siege of Quebec by General Wolfe (1759) ended with a battle on the Heights of Abraham in which both Wolfe and the French general, Montcalm, were killed. But the victory was with the British, and by the Treaty of Paris (1763) the whole of Canada—which the French king called “a few miles of snow”—became a British possession.

The American War of INDEPENDENCE (1775-1783) failed to draw the French-Canadians from their new allegiance to the British Crown, when the new United States was born, many British colonists, known as Loyalists, who did not wish to be cut off from Britain, moved to Canada. They found new homes in the scantily peopled districts of Manitoba, Ontario and New Brunswick, and

their arrival was of great advantage to Canada.

On the Pacific side of Canada, British Columbia became a Crown Colony in 1858, and was later united with Vancouver Island. By the British North America Act of 1867, the Canadian provinces were united to form the Dominion of Canada—the first dominion in the British Empire—with the right of self-government. In 1869, the territory of the Hudson's Bay Company was purchased by the Government and transferred to the newly formed dominion. But the Company still holds trading-posts and carries on business as it did in Prince Rupert's days.

Each province has its Provincial Assembly, and sends representatives to a Federal Parliament which meets at Ottawa. The Governor-General represents the King. By the famous Statute of Westminster (1931), Canada and other British Dominions became free and inde-

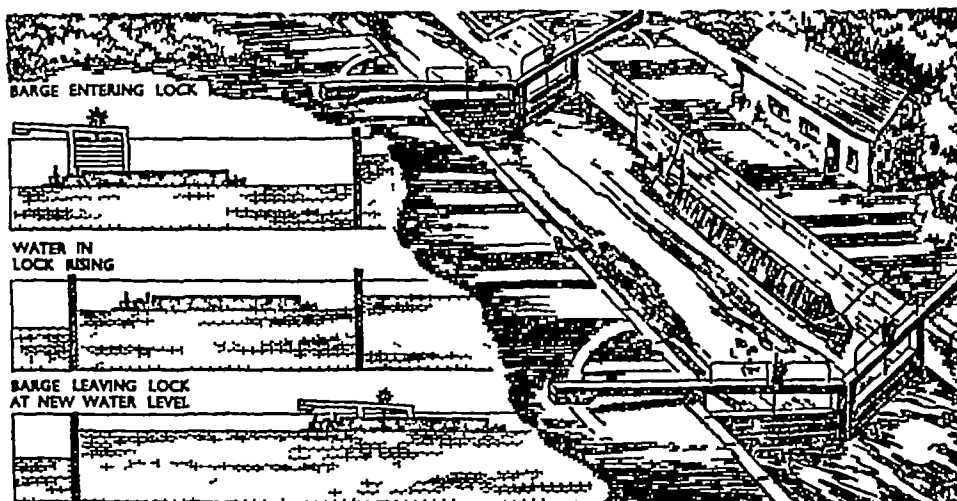
pendent nations in the British Commonwealth, equal in status to Britain and united by a common loyalty to the Crown. Canada has now become one of the most important of the smaller powers of the world, and she has close relations with the United States, her neighbour.

CANAL, an artificial waterway used by barges and other craft for the transport of heavy goods. Canals are still widely used, and are a cheap, but slow means of transporting such goods as coal, sand and bricks. Since they may have to climb over slopes well above sea level, canals must be cut up into lengths at different levels, separated by locks. These are pairs of gates with water valves or sluices; the barge moves into the space between the gates, the gate behind is locked and the sluice in front opened, so that water pours in, or out, as the case may be, until the water level in the lock is the same as that in the stretch of water ahead. Then the gate ahead is opened and the barge goes forward. Water for canals is drawn from rivers and springs. At the top or summit level, water is collected from all the

mountain streams and lakes, sometimes it must even be pumped up from lower levels to fill the canal to the depth required.

The Panama Canal, 50½ miles long with three sets of double locks, provides a route from the Atlantic to the Pacific which avoids the Cape Horn route round the south of South America. The Suez Canal, 100 miles long with no locks, saves nearly 4,000 miles on the sea voyage to the East from northern Europe. The Kiel Canal, 61 miles long with no locks, provides a short route between the Baltic and North Sea. The Manchester Ship Canal in England, 35½ miles long, connects Manchester with the Irish Sea. The Amsterdam Canal in Holland, 15½ miles long, provides a short route from Amsterdam to the North Sea. The Sault Ste Marie Canals in Canada avoid the rapids between Lakes Superior and Huron. The Welland Canal in Canada avoids the Niagara Falls between Lakes Erie and Ontario. The Caledonian Canal in Scotland connects several lochs between Inverness on the east coast and Fort William on the west coast.

CANARY. See CAGE BIRDS.



In a canal lock the water level can be made to rise or fall as required

CANDLE The material of a modern candle is a mixture of paraffin wax and stearic acid made from tallow. The wick is specially woven cotton. The wax melts, and runs up the wick, where it turns to a vapour which burns.

CANDLE POWER The brightness of a light is measured by comparing it with a certain standard candle. Consequently we say a lamp has 1,000 candle power if it is equal in brightness to 1,000 candles. See **PHOTOMETER**.

CANON comes from a Greek word meaning "rule." It has three meanings connected with religion: (1) the laws of the Church, (2) a priest who serves at a cathedral, (3) the list of books chosen for inclusion in the Bible.

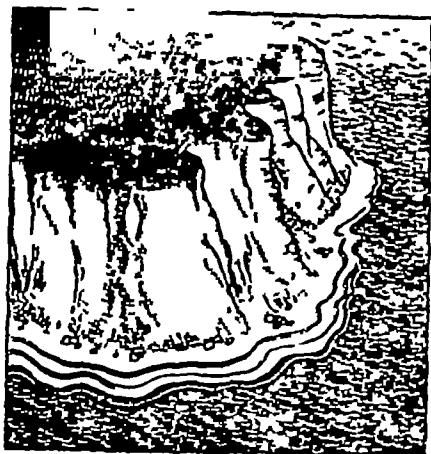
In music a canon is a song or instrumental piece in parts, in which a tune having started is followed after an interval by a shadow or echo of itself. A round, like "Three Blind Mice," is a simple type of canon.

CANYON (Canyon), a deep, narrow valley with almost vertical sides, found in western North America where rivers flow across rainless regions to reach the sea. The Grand Canyon of the Colorado River in the United States is 200 miles long and 7,000 feet deep in places.

CANTATA, a work for chorus, with or without soloists and orchestra, meant to be performed without stage action or scenery.

CANTILEVER A beam is said to be used as a cantilever if it supports a load on an overhanging end and is itself supported in the middle, the load being balanced by weights at the other end of the beam. Most cinema and theatre galleries are cantilevers. See **BRIDGE**.

CAPE, in geography, a headland or corner of land jutting boldly into



Cape jutting into the sea

the sea, e.g. Lizard Point in Cornwall and Beachy Head in Sussex.

CAPILLARY ACTION which causes liquids to rise in capillaries, i.e. narrow tubes, results from the attraction between the molecules themselves of the liquid (see **SURFACE TENSION**) and their adhesion to the capillary wall. If one end of a porous substance (one full of holes), such as blotting paper, is placed in a blob of ink, the ink will rise up the substance. Similarly, moisture with plant food dissolved in it will ascend the tiny channels in the stem of a plant.

CAPITAL is used in many senses. In economic theory, capital is an essential factor in the production of wealth. If on Robinson Crusoe's Island, Robinson Crusoe builds himself a boat, then he can catch more fish. He can increase his wealth. If he saves seed to plant for the next year's harvest, then his boat and his seed are part of his capital. Britain's capital consists of her roads, railways and airways, her ships and dockyards, her mines and machinery. With this capital she is able to produce more and increase her wealth. These

would make up her material capital. The knowledge of how to use the machines, engines and planes would be her non-material capital. For what is the use of her ships or planes if no one knows how to use them?

There are more restricted uses of the term capital. Financiers use capital to mean the money available for loans. The use of money is bought and sold in the capital market, money can be borrowed, or its use bought, for short or long periods. This money is generally used to assist PRODUCTION. The borrower may buy a new machine with which he hopes to produce more and so pay off the loan as well as the interest for the use of this money.

There is also a commercial use of the term capital, as for example in the capital of a company. Every joint stock COMPANY is formed with authorized capital, the amount of which is stated in the memorandum of association. Capital in this sense is the amount of money subscribed by the shareholders.

In an even more restricted sense, bookkeepers and accountants will use the term capital as signifying the excess of a company's assets over its liabilities. The capital of a company will consist also of its goods, its machinery, property, patent rights and its GOODWILL.

An industrial system is known as a capitalist system when the owners of the capital or means of production are the relatively few who employ other people with little property or capital. When the state owns the capital and employs the people, it is a socialist system.

CARBIDE, CALCIUM, is made in an electric furnace from coke and lime. It is a grey, stony solid which gives off the inflammable gas acetylene when treated with water, and some bicycle lamps use it.

CARBOHYDRATES are a group of substances composed solely of carbon, hydrogen and oxygen, and forming the chief energy-producing elements in food. Common examples are starch and sugar. See DIET.

CARBON is one of the most important ELEMENTS, the basis of all ORGANIC materials and essential for living creatures. Its common and more or less pure forms are diamond, graphite, lampblack and coal. When heated strongly in air all these burn to form a gas CARBON DIOXIDE, and give out much heat energy.

CARBON DIOXIDE is a gas formed by burning carbon. It is also given out in the breath of living animals and plants. It is denser than air, puts out a flame and turns lime-water milky. Many drinks contain dissolved compressed carbon dioxide, which gives a pleasant sharp taste to the liquid. See ICE (DRY).

CARICATURE, a drawing of a person, in which certain physical characteristics are exaggerated in order to make the drawing grotesque.



Caricature

or comic. Such drawings often form the basis of the humorous and political cartoons appearing in the press.



Lewis Carroll, children's author

CARLYLE, Thomas (1795-1881), was a Scottish schoolmaster who turned essayist, historian, lecturer and biographer. He settled in Chelsea and became a resounding voice of the Victorian era. In 1835 he wrote the first part of his *French Revolution*, it was accidentally burnt while in the possession of John Stuart Mill, but Carlyle rewrote it. It is a striking work—better literature than history—written with the colour and rhetorical emphasis which Carlyle made his own, and which none successfully imitated. Carlyle was interested in political and economic problems, and developed a contempt for democratic rule and an over-simple faith in the "strong man." *On Heroes and Hero-Worship* and *Past and Present* contain much of his social outlook. He edited Cromwell's speeches and letters, and spent fourteen years on a history of Frederick the Great.

CAROL, a joyful religious seasonal song implying the idea of

open-air dancing, and so having a jolly rhythm and a good deal of secular feeling in it. Carols are associated with Church festivals such as Christmas or Easter, but were perhaps intended more for performance outside the church.

CARROLL, Lewis (1832-1898), was the pen-name of Charles Lutwidge Dodgson, a lecturer in mathematics at Oxford from 1855 to 1881. He was fond of children, and wrote his celebrated *Alice's Adventures in Wonderland* and *Through the Looking-Glass* for the small daughter of friends. Some of the curious words he invented, such as "chortle," have been adopted into the language.

CARTIER, Jacques. See CANADA and EXPLORATION.

CASE. See GRAMMAR.

CASPIAN SEA, a large inland sea lying between Europe and South-West Asia. See map of ASIA.

CASSOWARY. See OSTRICH.

CASTOR OIL is an oil extracted from the seeds of the castor oil plant. It is used for lubrication and as a purgative.

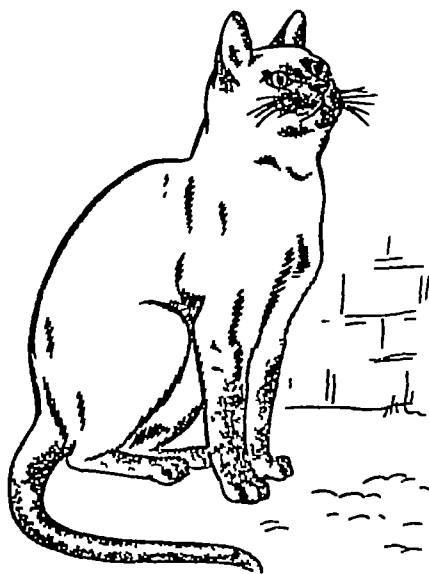
CAT, a family of FLESH-EATING MAMMALS including the lion and leopard of Africa and India, the tiger of India and the Far East, the jaguar and puma of Central and South America, and the widely distributed lynxes. All have claws which can be withdrawn into sheaths. They walk silently on their padded toes, stalking their prey by night. The larger cats roar. True wild cats still live in the Scottish Highlands and Wales. Domestic cats are derived from several species of wild cat, including an Egyptian form. Some favourite breeds, among very many, are long-haired Persians, tailless Manx cats, British Blues, and the Siamese which have black ear-tips and paws and blue eyes. Cats are

useful in destroying rats and mice

CAT AS A PET. Cats can be just as intelligent as dogs, but remember that they have a self-sufficiency that must be respected. Don't expect a cat always to be ready to fall in with your wishes, as a dog is

Cats should have a box or basket of their own. One of a reasonable size with short legs to keep it from floor-draughts is best. Line it with several layers of brown paper and fold an old blanket into a snug mattress. This can be shaken out at regular intervals, which helps to keep away fleas.

All cats, whether in town or country, should have in some retired corner a box of sand or sifted ashes which is changed every



Siamese cat, a popular breed

day or so. Cats are very clean and particular in their habits, but no cat will use a wet, smelly, neglected sanitary box.

Give them two meals daily—bread and milk in the morning and a meat meal (occasionally raw) with greens and gravy at night. Kittens will need extra milk. Feed them at

regular intervals and do not let the food lie around to get dusty and infected. Hungry cats are bad mousers, remember, so don't try to starve your cat into catching mice! Never give cats raw offal; it must be cooked to destroy any lurking parasites. If your cat lives in town you must grow cocksfoot grass for it as a general medicine and tonic. You will have to make successive sowings to maintain a continuous supply of grass.

Long-haired cats need brushing, especially when the spring and autumn coats appear. Any cat welcomes grooming, since it eases its own share of the toilet.

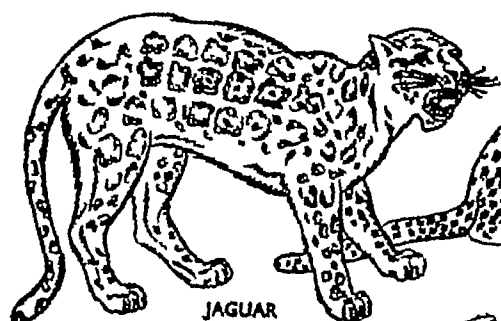
Never lift a cat or, particularly, a kitten, by the armpits. This can cause serious displacement of the organs and it may die. Lift gently by the scruff of the neck and support the weight with the other hand.

Common ailments are canker in the ear, worms and influenza. Cure the first by clearing the ears with warm oil and boracic lotion, the second with powders that you can get from any chemist, but for anything else consult a vet.

CATALYST, a substance which, without itself undergoing any apparent change, helps a chemical reaction to proceed rapidly in other substances.

CATCH CROPS are quick-growing crops like lettuce, radish, spring onions, and mustard and cress, which are usually sown when the ground has been cleared of the main crop, and before the growing season has ended. Catch crops of carrot and beet may also be sown between the rows of the main crops and pulled for immediate use before they are fully grown.

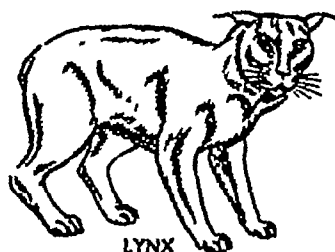
CATERPILLARS and SILK-WORMS, KEEPING. Be sure to notice what kind of plant you found your caterpillar on and feed it on



JAGUAR



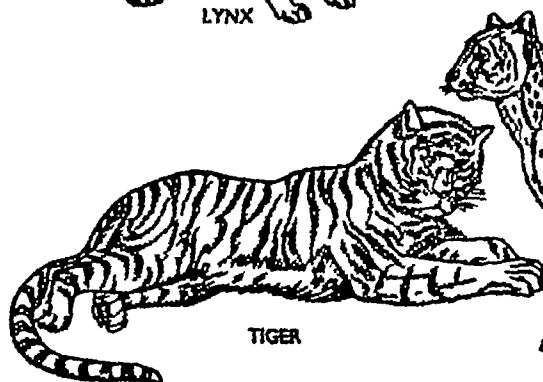
LEOPARD



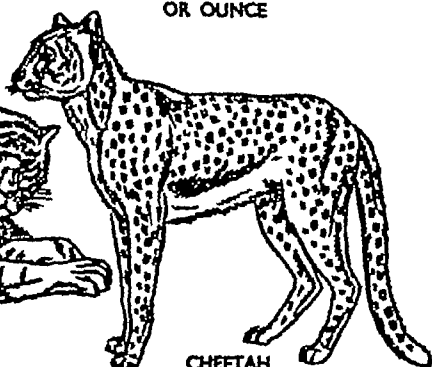
LYNX



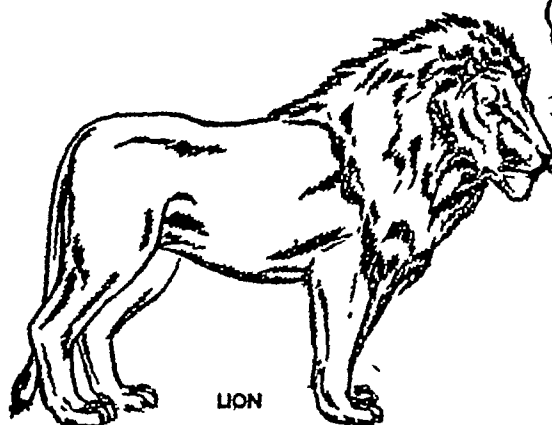
SNOW LEOPARD
OR OUNCE



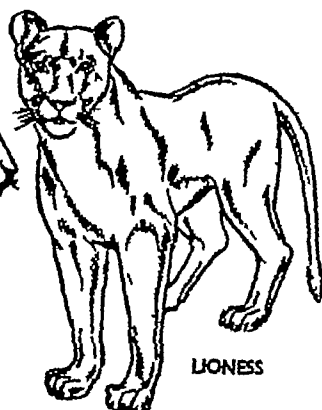
TIGER



CHEETAH



LION



LIONESS

Members of the cat family, which also includes the puma and the wild cat. All have claws which can be withdrawn into sheaths.

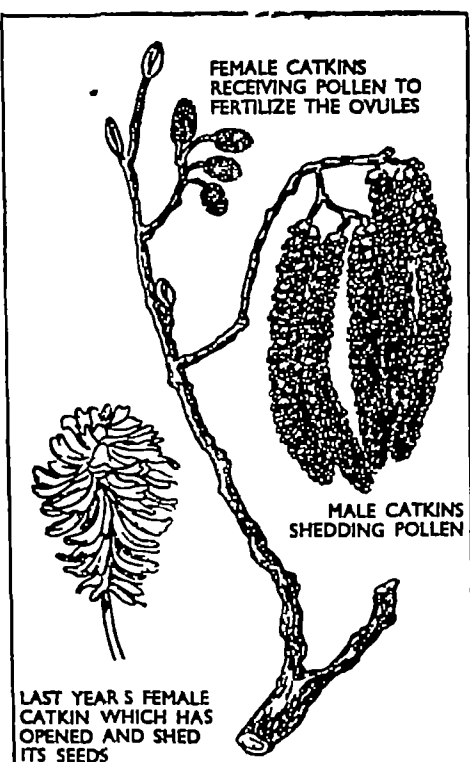
fresh sprigs of that plant. Stick the sprays in earth at the bottom of an empty aquarium or large jar and replace them as they fade. Keep the jar clean and cover it with perforated zinc or coarse cloth. caterpillars need air! Have a dry twig permanently stuck in the earth for the caterpillar to spin its cocoon on. When it does so, remove the green-stuff and store the jar, lightly covered, in a cool, dry, dark place until the spring.

Silkworm's eggs can be bought in spring. Keep them in a well-ventilated box until they hatch, then feed the young caterpillars on lettuce or, preferably, mulberry leaves. Treat them as you would any other caterpillars. When the silkworm retires to a corner to spin its cocoon, place it in a cone made from a twist of paper. You can spin the silk off the cocoons on a winder which you can buy at a pet shop.

If you have to lift them at any time, do so with a large water-colour brush. Your fingers are not delicate enough.

CATHOLIC CHURCH (of Rome) is the Christian Church whose head is the Pope, or Bishop of Rome. Its services are in Latin and its central service is the Mass. It brought Christianity to the British Isles, the Protestant Christian Churches being formed following the REFORMATION. Roman Catholics believe that the Pope is infallible when officially teaching faith or morals, and that their Church is the only true Church of Christ.

CATHOLIC EMANCIPATION. Many people in the 17th century—after the Protestant and Puritan revolutions—feared that Roman Catholics would be enemies of the State, and Acts of Parliament were passed to prevent them having any share in public affairs. The Test



Catkins of the alder tree

Act of 1673 prevented Roman Catholics (as well as Protestant Nonconformists) holding any public offices, the Disabling Act of 1678 prevented any Roman Catholic sitting in either House of Parliament. The Test Act was not repealed till a century and a half later, in 1828. The following year a popular Irishman, Daniel O'Connell, was elected Member for County Clare, but being a Roman Catholic was unable to take his seat. The Duke of WELLINGTON, who was Prime Minister, was faced with threats of an Irish Rebellion, and then the Catholic Emancipation Act was passed (1829), admitting Roman Catholics to Parliament and to most public offices. The few restrictions that remained have since been removed, and they may now hold any office except that of sovereign, regent (when one exists), Lord Chancellor, or the

Lord High Commissioner to the Church of Scotland

CATKIN. Hazel, alder, willow, poplar, birch, oak and many other trees bear clusters of flowers, often hanging in loose tassels called catkins. Each single FLOWER has either stamens or a pistil, and none have sepals or petals, since they are pollinated by wind. The male catkins (with stamens) and the female (with pistil) may grow on the same tree, e.g. hazel, alder, or on separate trees, as in willows.

CAVALIERS. See CHARLES I

CAXTON, William See EDWARD IV

CELEBES. See EAST INDIES

CELL, the unit of which all plant and animal bodies are composed. Cells are made of a complex substance called protoplasm, and contain a central part called the nucleus.

Everything alive begins as a living single cell, which multiplies by dividing itself. Thus cells of different types are formed, some capable of building up muscle, others tissue, others bone, others skin and so on. See AMOEBA.

CELLO. See VIOLONCELLO

CELLULOID is one of the oldest PLASTICS, made from camphor and cellulose which has been treated with acid. It is easily moulded and coloured, but highly inflammable.

CELLULOSE is a CARBOHYDRATE which forms the greater part of the cell wall of plants. Prepared from wood pulp, cotton and flax fibres, it is the raw material for the manufacture of PAPER, CELLULOID, EXPLOSIVES, ARTIFICIAL SILK, and many kinds of VARNISH.

CEMENT is any material having strong adhesive powers. The name, however, is usually used for Portland cement, a substance made by strongly heating together clay and chalk and finely grinding the result-

ing clinker. Mixed with water this powder sets to a hard mass. See CONCRETE.

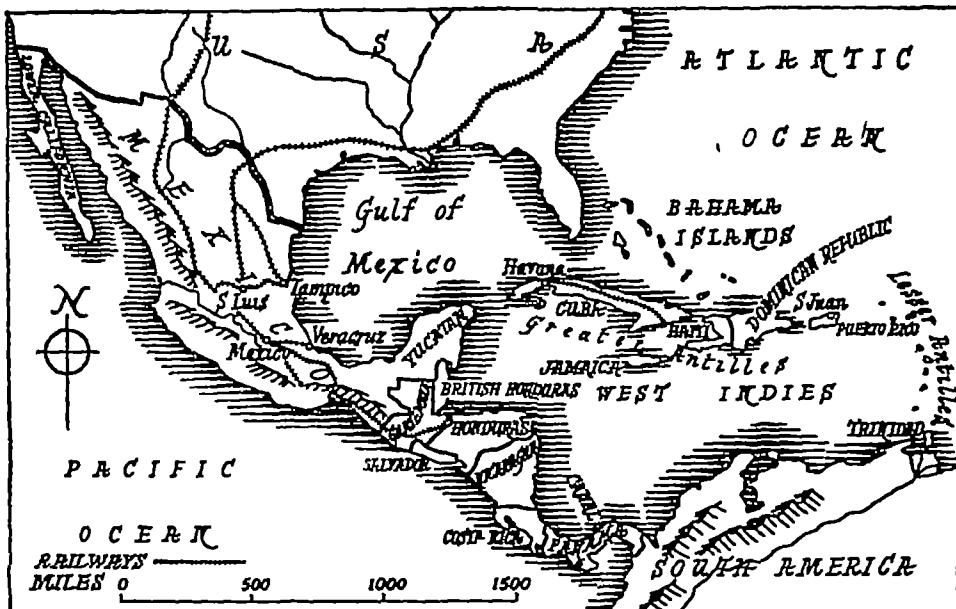
CENSORSHIP is the exercise of control over news, books, plays, films, so as to prevent anything unworthy from appearing. Democracies must be careful to see that censorship, if it exists at all, is not used for political ends, such as that of maintaining in power a particular government or form of government. In time of war, censorship must ensure that nothing of importance leaks out to the enemy.

CENSUS, the official counting of the population in a country. In Britain a census has been taken every ten years from 1801 to 1931. On these occasions every householder must enter on a census paper the names, ages, occupations, etc., of all those staying in the house on a given date.

CENTAURS, according to CLASSICAL MYTHOLOGY, are a race, having the lower part of their body a horse and the upper part a man.

CENTPEDE means "hundred feet." Several forms of centipede, with numerous, but not exactly 100 feet are found in gardens, where they are useful in eating smaller destructive animals. They, and the plant-eating millipedes, are ARTHROPODS related to INSECTS.

CENTRAL AMERICA consists of six republics, GUATEMALA, COSTA RICA, HONDURAS, NICARAGUA, SALVADOR and PANAMA, the 10-mile wide PANAMA CANAL zone, and the colony of BRITISH HONDURAS. The hot forested lowlands are damp and unhealthy, so most of the white people live in the cooler highlands. Their language and customs are Spanish. Exports include cocoa, coffee and bananas from plantations owned by white people, and mahogany, logwood and chicle from the



Map showing Central America, Mexico and the West Indies

forests Chicle is the sap of a tree from which chewing-gum is made Indians grow maize and beans on the plateau for their own food Communication between the states is largely by sea, but they are now connected by the Inter-American Highway The only populous area is Colon, Panama City, and the Canal Zone, a U S naval base



Fine example of ceramics

CENTRAL HEATING. See RADIATOR

CENTRIFUGAL PUMP. See PUMP (FIRE)

CERAMICS is the name given to a large number of products and crafts which have to do with the use of clay, or similar materials, all forms of pottery—vases, bowls and tiles, china-ware, and so forth—which have to be baked in a kiln and then glazed The making of pottery and its decoration is one of the oldest and most honoured of crafts, and one which at once calls to mind Josiah Wedgwood, who founded a works in Burslem and a large factory at Hanley in the 18th century and advanced the art and craft of pottery making in England

CERBERUS, in CLASSICAL MYTHOLOGY, is the three-headed dog that guards the entrance to HADES

CEREALS are a group of plants belonging to the GRASS family, which are cultivated to yield grain Wheat, barley, oats, maize, rye, rice, millet, etc., are sown as crops Many varieties of each, differing in amount

and quality of grain, ability to resist disease, etc., have been produced by selective breeding

CERES, in CLASSICAL MYTHOLOGY, is the goddess of agriculture and crops. See also PROSERPINE

CERVANTES, Miguel de (1547-1616), the creator of the world-famous *Don Quixote* who, his wits disordered by too many romances of chivalry, sets out with his prosaic comic squire, Sancho Panza, to seek adventure like a true knight-errant

CEYLON is a British Dominion, an island off the tip of India. Wide lowlands surround central highlands, and rice, copra, tea, rubber, and cacao are produced in the southwest. Other products are ebony and satinwood, sapphires, and graphite. The capital is Colombo. See map of INDIA

CHAIN STITCH. Join the thread at the right-hand end of the line. Bring the thread forward and hold it down with the thumb. Insert the needle into the same hole again and bring it out a little farther along the line, keeping the thread under it. Pull the thread through and repeat (See 1)

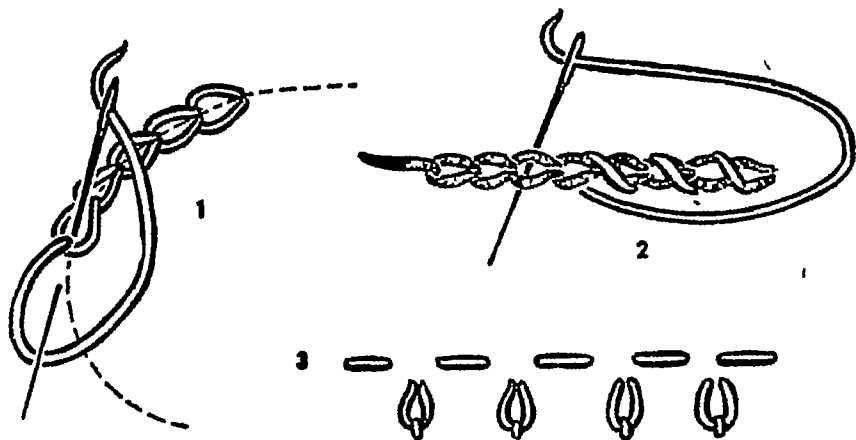
For *whipped chain stitch*, work a row of chain stitch as described above, with another thread, work



Three kinds of cereal

over and over into each stitch without taking up any material (See 2)

For *detached chain stitch*, work single chain stitches in a decorative way. The method of working is the same as for chain stitch, but tie each single stitch down with a tiny stitch (See 3)



Chain stitch, whipped chain stitch, and detached chain stitch

CHALK is a soft rock, largely calcium carbonate, formed from the deposited skeletons of minute sea animals. It absorbs water and is slightly soluble if the water contains dissolved carbon dioxide. Blackboard chalk is calcium sulphate which has been powdered and then compressed. French chalk is magnesium silicate.

CHAMBERLAIN. Joseph Chamberlain was born in London in 1836. His father was a well-to-do business man. On leaving school, Joseph spent a short time in his father's office, and then joined his cousin, Joseph Nettlefold, in a screw factory in Birmingham. His keen business ability brought him great success, and he was able to retire with a fortune at the age of thirty-eight.

He devoted himself to municipal affairs, and was Mayor of Birmingham from 1873 to 1876, during which time slums were pulled down and replaced by wide, paved streets, while an art gallery, a fine library, and public recreation grounds were opened. Chamberlain took great interest in the welfare of Birmingham University of which he was the first Chancellor.

In 1876 Chamberlain entered Parliament as a Liberal, but as he did not agree with Gladstone's plans to give Home Rule to Ireland, he became the leader of the Unionists. He held many important offices, including that of Colonial Secretary. After the Boer War (1899-1902) he visited South Africa, and did much to bring about more friendly feelings. In 1906, he retired from active public life on account of ill-health, and died in 1914.

Sir (Joseph) Austen Chamberlain, eldest son of Joseph Chamberlain, was born in 1863, and educated at Rugby and Cambridge. He entered Parliament in 1892, and

held many important Cabinet appointments, including Chancellor of the Exchequer (1903-1906), Secretary of State for India (1915-1917), and Foreign Secretary (1924-1929).

Neville Chamberlain, second son of Joseph Chamberlain, was born in 1869, and educated at Rugby and Mason College, Birmingham. After managing an estate in the Bahamas (1890-1897) he returned to Birmingham, and was Lord Mayor in 1915 and 1916. He entered Parliament in 1918, and was Chancellor of the Exchequer (1923-1924, 1931-1937). In 1938, when Prime Minister, he twice travelled by air to Germany to hold conferences with Adolf Hitler in the hope of preventing war, but was unable to do so. He was succeeded as Prime Minister by Winston Churchill in 1940 and died in the same year.

CHAMBER MUSIC is a general term used for music designed originally to be played by a few players in the privacy of their own homes rather than in a concert hall. The performers have equal status, and the music includes duet sonatas, trios, quartets, quintets, etc. MOZART, BEETHOVEN, and BRAHMS are among the best-known composers of chamber music.

CHAMBER OF COMMERCE, an association of merchants, manufacturers, traders and others in a city or area, whose aim is the promotion of trade.

CHAMELEON, a lizard whose colour varies with emotion or background. Its swivel eyes can be moved independently. It eats insects caught by the sticky club-shaped tip of its tongue, which can be shot out to more than the body's length.

CHANCELLOR OF THE EXCHEQUER. See PARLIAMENT.

CHANNEL ISLES, a group of islands off the French coast, part of

the former French territories of William the Conqueror and ruled by the British Crown under lieutenant-governors French is the official language though English is also widely used Tomatoes, early vegetables, stone and granite are exported, and the islands are a popular tourist resort The largest are Jersey and Guernsey See the map of FRANCE

CHAPBOOK, a roughly printed ballad or story, often illustrated by woodcuts, and hawked by a travelling pedlar or chapman, especially in the 18th century

CHAPEL, a church or place of worship which is not a parish church A school church, a small section of a church which has a separate altar, and some Non-conformist churches are also called chapels

CHAPLAIN, a clergyman who is appointed to conduct services in a Royal chapel Clergy who work in the Army, Navy, Air Force, prisons, schools or hospitals and similar institutions are also called chaplains



Chameleon catching its food

CHARCOAL is impure carbon, very light and porous, formed by strongly heating wood away from air Since it gives no smoke, it is used as a cooking fuel in rooms with no chimneys It also absorbs colouring material from solutions, and heavy gases by **ABSORPTION** and is used in gas masks

CHARLEMAGNE (743-814), Charles the Great, was King of the Franks during the 8th century During his long reign of forty-six years, he extended the power of the Franks, and forced the heathen Saxons to accept Christianity He also carried on wars with the Lombards and other tribes in the north of Italy in defence of the Pope On Christmas Day, 800, the Pope and Charles attended a service in St Peter's Church, Rome, where the Pope crowned Charles as Emperor of the Holy Roman Empire, and addressed him as Charles Augustus This was the beginning of that famous Empire which played an important part for a thousand years in European history to the 19th century when Napoleon destroyed it

Charlemagne built splendid palaces at Aix-la-Chapelle and Ingelheim, near Bingen on the Rhine He also built many churches and schools, and took a personal interest in the education of his younger subjects, in which he persuaded the English scholar, Alcuin, to help him Charles could speak Latin and read Greek, but though he tried hard he could never write more than his own name

He was buried at Aix-la-Chapelle. See **DARK AGES** and **MIDDLE AGES**

CHARLES I (reigned 1625-1649), succeeded his father, James I, as King of Great Britain and Ireland He married the French and Catholic princess, Henrietta Maria Charles was a good man, but an

unwise king, like his father, he believed in "the Divine Right of Kings," which set them above the law. During the first four years of his reign, three parliaments were summoned and dismissed. The third of these parliaments passed the famous Petition of Right (1628) which (among other things) asked the King to agree that taxes raised without the consent of Parliament were illegal. Charles dismissed Parliament, and then ruled for eleven years (1629-1640) without calling another, his chief advisers being Thomas Wentworth (Lord Strafford) and Archbishop Laud, who was strongly opposed to the Puritans. Scotland was enraged by Laud's attempt to force the English form of service on the Scottish Church.

The need for money forced Charles to summon Parliament in 1640, and when it met it at once ordered the arrest of Strafford and Laud. Strafford was tried and



Charles I : views his troops

beheaded in May, 1641, but Laud was kept a prisoner in the Tower until 1645 when he, too, was put to death.

In January, 1642, Charles did a very rash act when he tried to arrest five members of the House of Commons. Civil war broke out. The King left London, the stronghold of the Parliamentary cause, and went to York. Later, he made Oxford his headquarters. The followers of the King were known as Cavaliers. The supporters of Parliament were called Roundheads, and they found a great leader in Oliver CROMWELL with his troop of Ironsides.

The chief battles in the war were Edgehill (1642), Newbury (1643), Marston Moor (1644) and Naseby (1645). At Naseby the royalist army was routed, and Charles left his last refuge, Oxford, to give himself up to the Scots at Newark. They handed him over to the English Parliament, and for three years he was a prisoner at various places, including Carisbrooke Castle in the Isle of Wight. Then he was tried and sentenced to death. He was beheaded in 1649.

CHARLES II (reigned 1660-1685), was nineteen years of age when his father, Charles I, was beheaded. The young prince had previously escaped to France. He made an unsuccessful attempt to recapture the crown, but was defeated by CROMWELL, first at Dunbar, in Scotland (1650) and then at Worcester (1651).

After the death of Cromwell, Parliament invited Charles to return as king. The Restoration, as it is called, took place on 26th May, 1660, when Charles landed at Dover, and was received with great joy.

Charles married Catherine of Braganza, a Portuguese princess. She received as part of her dowry



Great fire of London during the reign of Charles II

the island of Bombay which Charles sold to the East India Company

Remarkable events of Charles's reign were the Plague of London (1665) and the Great Fire of London (1666) Two notable Acts of Parliament were passed—the Test Act, which excluded all persons who were not members of the Church of England from holding public offices, and the Habeas Corpus Act, by which no person might be kept in prison without being brought to trial

The King's heir was his brother, James, Duke of York, who was unpopular because he was a Roman Catholic This led to various plots, including the Rye House Plot, which aimed at making the Duke of Monmouth Charles's successor to the throne

Charles II died in 1685

CHARLES V (1500-1558), a very powerful monarch of the 16th

century He was the son of Archduke Philip of Burgundy and Joanna, daughter of Ferdinand and Isabella of Spain At the age of eighteen he became King of Spain (1518) and succeeded to his Habsburg domains in the following year He was elected Holy Roman Emperor and crowned at Aix-la-Chapelle in 1520 Shortly afterwards he presided over the Diet (or Council) of Worms on the Rhine at which the Protestant reformer, Martin LUTHER, was placed under the ban of the Empire and outlawed Luther was, however, seized and guarded by powerful friends until the danger was over See REFORMATION

The history of western Europe during the first half of the 16th century was largely that of the rivalry between Charles V and Francis I of France who coveted the dignity of Emperor There was

almost continuous warfare, with HENRY VIII of England and the Pope taking now one side, now the other Charles also waged war against the PIRATES of Tunis and Algiers, and protected his eastern frontiers from the Turks However, Charles V failed to carry out his dearest plan, namely to destroy Protestantism in the Empire Disappointed and ill, he handed over his Netherlands possessions to his son, Philip, resigned the imperial crown, and retired to a monastery in Spain, where he died

CHARLIE, Bonnie Prince See JACOBITES

CHARON, in CLASSICAL MYTHOLOGY, is the ferryman who ferries the dead over the STYX to HADES

CHARTISTS were supporters of the People's Charter which demanded Universal Suffrage (every man to be able to vote), Vote by Secret Ballot (to prevent bribery and threats), Annual Parliaments,

Payment of M.P.s, the division of the country into equal Electoral Districts, and the abolition of Property Qualification for seats in the House of Commons Since the early 19th century when these demands were first made, most of them have been granted, but between 1836 and 1848 there were many Chartist riots

CHARYBDIS and **SCYLLA**, in CLASSICAL MYTHOLOGY, were two dangerous hazards in the Strait of Messina Charybdis was a monster who swallowed up the sea and casting it up again caused a whirlpool, on the rock opposite lived a terrible monster (Scylla) with six long necks and heads

CHATHAM, Earl of See **PITT CHAUCER**, Geoffrey (about 1340-1400), was in 1357 a member of the household of Lionel, Duke of Clarence, son of Edward III In 1359 he was taken prisoner in France during the Hundred Years

War, but was ransomed, the King himself contributing In 1367 he was granted a pension for life of twenty marks a year, his wife, Philippa, having received in 1366 a life pension of ten marks a year as one of the queen's ladies

On St George's Day, 1374, he was granted by the king a daily pitcher of wine, which was later replaced by a money grant In the same year he leased the gatehouse at Aldgate, and was made controller of customs, as well as receiving an additional pension of £10 a year from John of Gaunt, fourth son of Edward III In 1386 he sat in Parliament

Chaucer's fortunes changed when the Duke



Chaucer wrote stories in verse



Chekhov, Russian writer

of Gloucester, uncle of Richard II, was the real ruler of England. But the fall of Gloucester restored his position, and he enjoyed Richard's patronage, his *Legend of Good Women* being offered to the queen, Anne of Bohemia. He was buried in Westminster Abbey, the first to lie in Poet's Corner.

In his early days Chaucer was influenced by French literature, which had set a fashion in polished courtly verse, remote from real life and passion, but pretty in an artificial way. As he developed, however, he turned to the world of ordinary men and women, and in less polished style learned to hit them off in a phrase. His most famous work is the *Canterbury Tales*. These consist of a number of stories drawn from various sources, and now supposed to be told by Chaucer's characters while on pilgrimage to the shrine of St Thomas of Canterbury.

CHEKHOV, Anton (1860-1904), was one of the world's greatest writers of the short story. He was, too, a dramatist, who, in *The Sea-*

gull, *Uncle Vanya*, *The Three Sisters* and *The Cherry Orchard*, tells us much about human nature while exhibiting well-to-do Russian provincial life of fifty years ago.

CHEMISTRY is the science dealing with the composition of substances, the way in which they are made up, and their action upon one another when they are brought together under various conditions.

CHEQUE, a written request to a BANK to pay to the person named a sum of money stated on the cheque. By writing "& Co" between two parallel lines across the cheque, the person making out the cheque ensures that whoever receives it must pay it into a banking account and can in no circumstances take it to a bank for cashing straight away—a safeguard lest the cheque fall into the wrong hands.

Cheques require a 2d stamp, which is usually impressed on it. The right to draw a cheque is obtained by depositing money in a bank or by arranging with the bank to borrow money from it. Cheques help business transactions,

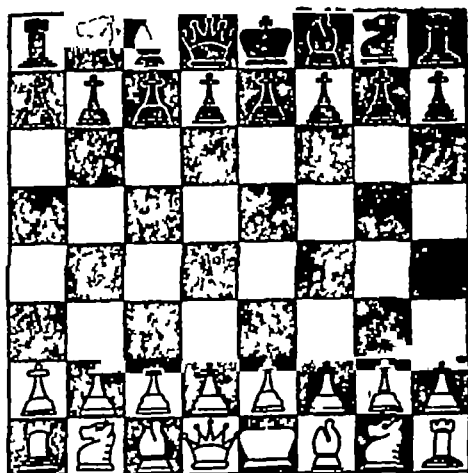
11714 Jan 4th 1967	
COUNTRY BANK LIMITED	
Pay <u>H. J. Smith Esq</u>	or order
the sum of <u>Forty Five Pounds</u>	
<u>£45-0-0</u>	S Brown
NOV 1966	

How a cheque is made out

for payment can be made by cheque instead of in cash. The illustration shows that S Brown is paying £45 to H J Smith. When Mr Smith pays the cheque into his own banking account he endorses the cheque, that is, he writes his name on the back, and this can be made to serve as a receipt, as the cheque after payment will come back to Mr Brown. If both payer and receiver

deal at the same bank, the banker will deduct the amount from the account of the drawer and add it to the account of the receiver of the cheque. But if the payer of the cheque draws on one bank and the receiver pays the cheque into a different bank, then it is necessary to have some system whereby the cheque can be returned to the payer's bank for deducting from his account. This exchange is done at a Clearing House, where representatives of the various banks meet and exchange cheques drawn on the other banks which each has received. See also OVERDRAFT.

CHESS is a game between two players played on a board, each player having sixteen men, one set being black and the other white. The men and board are set up as in the diagram. The small men in each front rank are known as Pawns, the larger men on the back ranks, as Pieces. Their moves are as follows: the Pawn moves straight forward across the board towards the opponent's men, either one or two squares with its first move, but only one square at a time thereafter; the King moves one square at a time in any direction; the Queen as many squares in any direction in a straight line as desired; the Bishop, keeping to the colour of the square on which it stands, in any direction in a diagonally straight line as far as desired; the Knight, two squares straight forward then one square right to the side in any direction; and is the only man allowed to jump over another, Rook (or Castle), as many squares in a straight line either forward, backward, or sideways but not diagonally, as desired. Only one man can be on a square at a time. Hence a man cannot go to a square already occupied by another man of the same colour, if



Chess men ready for play

the square has a man of the other colour on it, then that other man can be removed from the board in order that the square may be occupied, that is, one man "takes" the other man of a different colour. A Pawn, however, takes on the next square in a forward-sideways direction; it cannot move straight forward if the square in front of it is occupied. If, when a Pawn moves two squares on its first move, it jumps over a square where it could be taken by an opposing Pawn, then that opposing Pawn may move diagonally forward on the opponent's very next move to take the Pawn as if it were standing on the square over which it has jumped: this is called taking *en passant*.

Once only during a game, each player is allowed to castle, which means to move the King two squares, to the right on the King's side or left on the Queen's side, then take the Rook over the King and place it on the square next to the King on the other side. To do this there must be no piece in between, neither King nor Rook must have previously moved, and no square over or into which the King moves may be commanded

by an opponent's piece, the King cannot castle when in a position in which he might be taken by an opposing man, that is he cannot castle out of "check"

The King cannot be taken, but the object of Chess is to get him into such a position that he cannot escape

When a player can, on his next move, "take" the King he calls "Check," and the opponent must at once move it to safety, or interpose one of his men, if he is unable to do this, it is "Checkmate"—and the game is lost for him

White opens, usually by moving one of his centre Pawns, then Black moves, and so on alternately. The object of the opening Pawn play is to control the centre of the board and free the Pieces on the back rank so that they may join in the battle. Sometimes a player gives away a man in order to obtain a rapid development of his Pieces: this is known as a gambit. Pawns and Pieces may or may not be captured as the players fight for good attacking positions, a game may be won with hardly a man lost, sometimes the board becomes almost empty of men: then the struggle revolves round the ability to get a Pawn or Pawns into a square on the opponent's back rank, a Pawn doing this is replaced by a Piece, and as such can contribute to victory. This struggle occurs only in the "end-game"

In Chess each move must be considered very carefully, and all possible replies by the opponent taken into account. A knowledge of the various ways to open the game is useful, control of the centre of the board enables you to build up an attack, in that attack see that you have sufficient Pieces able to play an effective part. Chess openings and general play can be learnt

from a good book on Chess, as also can the easy symbols used for indicating the movements and positions of the various men

CHIANG KAI-SHEK See CHINA

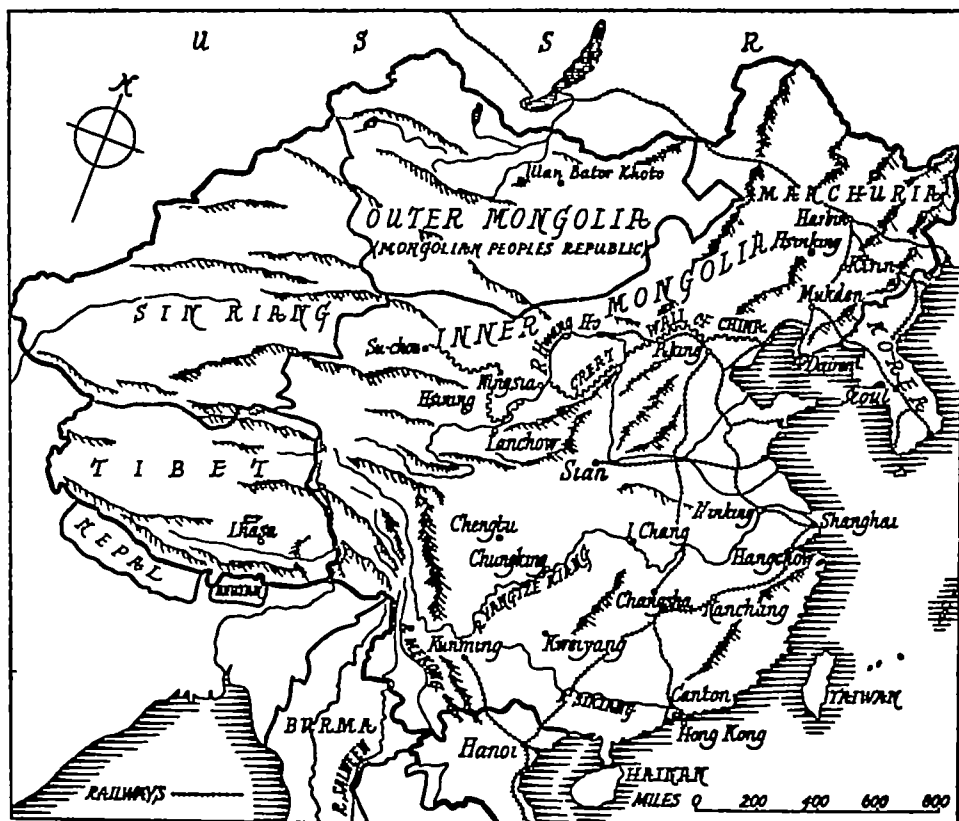
CHILE is a long stretch of country on the western coastal strip of South America. Central Chile has a Mediterranean climate, the north is mostly arid plateau. The chief towns are Santiago, the capital, and the ports of Valparaiso and Antofagasta. The main exports are copper, nitrates, iodine and wool. See map of SOUTH AMERICA

CHILTERN HUNDREDS. It is part of British Parliamentary tradition that a Member of Parliament may not resign his seat. If he wishes to withdraw from Parliament he applies to become the Steward of the Chiltern Hundreds, who in theory is a paid officer under the Crown. As such, he is ineligible to hold his seat, and a new M.P. has to be elected to take his place.

CHIMAERA, in CLASSICAL MYTHOLOGY, is a monster with a lion's head, a serpent's tail, and a goat's body, killed by Bellerophon on the winged horse PEGASUS

CHIMPANZEE. See APE

CHINA is the second largest country in Asia. In the west are huge mountain areas from which the great rivers Hwang Ho, Yangtze Kiang (Yellow River), and Si-kiang run to the Pacific. Most of the people live in the valleys and deltas of these rivers, where the rich soils produce several crops a year. Intensive farming is practised, but the peasants are very poor, owing to the internal and external wars that have ravaged the country for a generation. Rice is the chief food crop in the south where silk and tea are also produced. In the north the chief crop is wheat or millet, other products are soya and



Map of China showing the independent states along its border

cotton Enormous reserves of coal, iron ore and oil are as yet untapped Communications are poor, except along the great rivers

Some of the inland mountain areas such as Sin Kiang are in practice independent, part of Inner Mongolia has been declared independent, and Outer Mongolia is really an independent country, the Mongolian People's Republic See also TIBET

Nanking is the capital of China Other important towns are Peking, the old capital, Canton, the port for South China, and Shanghai The island of Hong Kong off the south-east coast, together with some smaller islands and a strip of mainland, forms a British Crown colony The capital is the port, Victoria

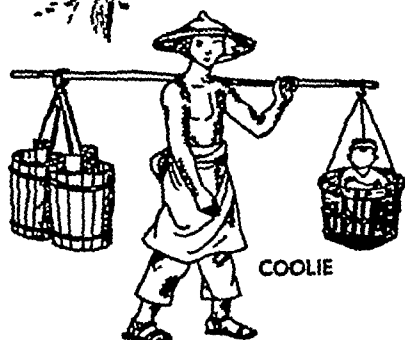
History China has one of the oldest civilizations in the world, and

her great teacher, Confucius, has for centuries been of world-wide fame Its government, based on the family, remained unchanged for centuries For 2,000 years the Emperor was the supreme head of the state In 1911 reforms were demanded, and finally a revolution took place The Emperor was allowed to abdicate, and a Republic was proclaimed The first President was Dr Sun Yat-sen

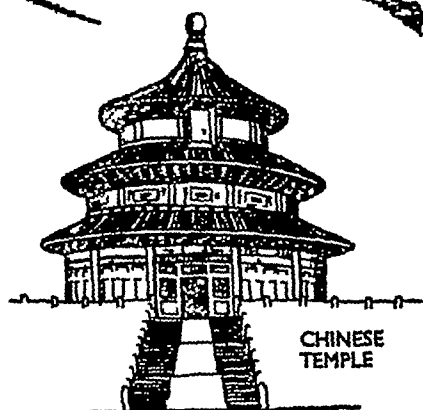
Even before the Second World War, China suffered greatly from the wandering gangs of bandits within the country, and from the attacks of the Japanese from without In 1932 the Japanese encouraged the province of Manchuria to declare its independence from China In 1937 "a state of war" existed between China and Japan, till Japan's fall in 1945. The



GREAT WALL OF CHINA



COOLIE



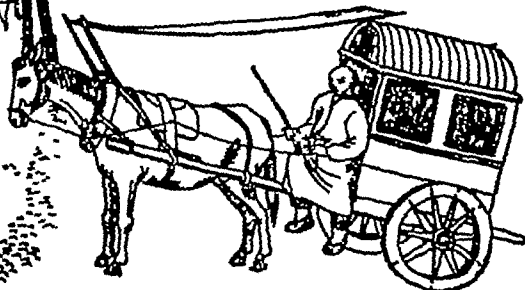
CHINESE
TEMPLE



FARMERS GATHERING RICE



STREET SCENE



TILTING-CART

Scenes from modern China, a great Asiatic country of many people, with one of the oldest civilizations in the world

"strong man" of China in the Second World War was Generalissimo Chiang Kai-shek head of the government, he helped to keep the Japanese from overrunning the whole of the vast land of China. By his efforts many of the parties in China were united, and troops sent against the Japanese. When his headquarters at Nanking fell to the Japanese, he retired to Chungking, 1,200 miles from the coast, in a district with many natural caves affording shelter from air raids.

With the defeat of Japan, China now undoubtedly has before her a great future in Asia and the world and the opportunity to become a great power. Yet China has much leeway to make up. The people on the whole are poor, living mainly on rice grown and gathered in the flooded fields. Transport is difficult over the rough roads and much carrying is done by coolies. The Great Wall of China, built in the 3rd century B.C. against invaders, still serves as a road for foot travellers across the hills of North China. It is the rivers which are the great highways of communication, and the picturesque junks sail up and down laden with goods and passengers as far as the depth of water will allow them.

The Chinese people do not all belong to one religion; there are several religions, chiefly Taoism, Confucianism, and Buddhism, and their ancient temples everywhere raise their tiers towards the eastern sky.

CHINA CLAY, the material used for making pottery, is a white insoluble earth formed when certain rocks are weathered. It is plastic when wet, which enables it to be moulded easily, but after strong heating it changes and can never be softened again by water. See also **CERAMICS**.

CHLOROFORM is a sweet-smelling, volatile, **ORGANIC** liquid which is an anaesthetic when inhaled. It is made from alcohol and bleaching powder.

CHLOROPHYLL is the green colouring matter present in all plants, with the exception of fungi and some parasites. Chlorophyll is present in small bodies called chloroplasts within the cells of leaves and stems. It is formed when the young plant's shoot reaches light, and is necessary to the plant in making its food. See **PHOTOSYNTHESIS**.

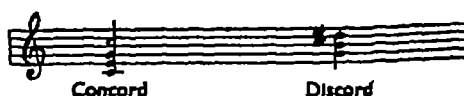
CHOIR, a group of singers. These may be (1) mixed voice choirs, consisting of soprano, alto, tenor, and bass singers; (2) male voice choirs—first and second tenors, baritones, and basses, or (3) female voice choirs—sopranos and altos.

CHOPIN, Frédéric (1810-1849), Polish **ROMANTIC SCHOOL** composer who wrote most of his works in France. His works include mazurkas and polonaises, which convey in music many national Polish characteristics. In addition he wrote studies, waltzes, **PRELUDES**, **NOCURNES**, and many other charming solo works for the piano, and two **CONCERTOS** for piano and orchestra.

CHORALE (or Choral), a hymn-tune of the Lutheran Church—much loved, harmonized and used by Johann Sebastian **BACH** in his choral and organ works.

CHORALE PRELUDE, a piece of organ music decorating a **CHORALE**, upon which it is based.

CHORD, in *music*, notes of different **PITCH** sounded together.



Notice the difference

Some chords have a pleasing and satisfying effect, since the notes all harmonize one with another, they are concords. Other chords clash on the ear, or feel unsatisfactory by themselves, these are known as discords. Chords form the basis of HARMONY.

In *mathematics*, a chord is a line across the CIRCLE.

CHRISTIANITY is the religion of people who believe in Christ.

Briefly, Christians believe that God is the Father who created and controls the universe, and that God sent His Son, JESUS CHRIST, into the world to save us from our wrongdoing and show us that God is love. Christians worship Him together on Sundays and other days, pray to Him and read the BIBLE. See CHURCH and HOLY SPIRIT.

CHROMIUM is a hard white metallic ELEMENT which, because of its resistance to corrosion, is widely used for ELECTROPLATING exposed pieces of metal. It is also used in the making of stainless steel.

CHRONOMETER, an accurate type of clock developed to enable navigators to find their longitude by the sun. See also SEXTANT.

CHURCH has two meanings:

(1) a building in which God is worshipped, (2) the followers of Christ. The first great MISSIONARY of the Christian Church was St. PAUL. The Church grew very rapidly and by A.D. 313 was recognized by the Roman Emperor Constantine. The word is now also used by various kinds of Christians to distinguish their own variety of Christianity. See BAPTIST CHURCH, CATHOLIC CHURCH, CHURCH OF ENGLAND, CONGREGATIONAL CHURCH, GREEK ORTHODOX CHURCH, METHODISTS, PRESBYTERIANISM.

CHURCHILL, Winston (born 1874), son of Lord Randolph Churchill, and grandson of the



Winston Churchill

7th Duke of Marlborough, was the intrepid British Premier during the Second World War. He was educated at Harrow and Sandhurst, and entered the Army in 1895. He served in the 4th Hussars and 21st Lancers, and saw active service in India and Egypt, in South Africa, during the Second Boer War (1899-1902) he acted as war correspondent for the *Morning Post*. He was taken prisoner by the Boers, but managed to escape.

He entered Parliament in 1900, and held various offices. During the First World War, he was First Lord of the Admiralty, and later, Minister of Munitions. At the Armistice he became Minister for War. In 1924 he was Chancellor of the Exchequer.

When the Second World War broke out, he was M.P. for Epping, and in 1940 he became Prime Minister. He made several journeys by air and sea to confer with President Roosevelt and Marshal Stalin. He resigned when the Labour Party won the election in 1945. His wonderful speeches,

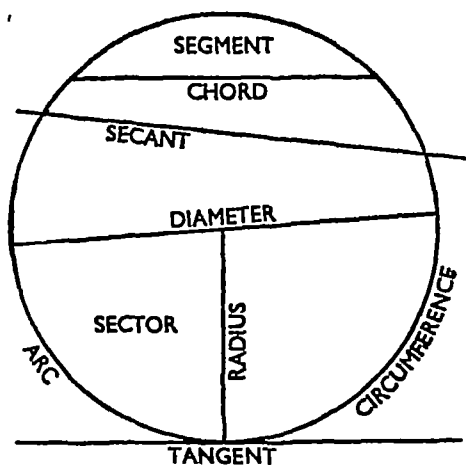
unfailing courage and great leadership, especially in the darkest days of the war, inspired not only Britain but all freedom-loving peoples of the world

CHURCH MUSIC is among the oldest music in the world. Some of its tunes were in use in the Hebrew temple, others in the catacombs, where the early persecuted Christians sang hymns together. For about the first thousand years of Christianity all the hymn tunes were sung in unison, and are now known as "plain-song." Then, after experiments in combining tunes (see **COUNTER-POINT**) there arose the great polyphonic school, culminating in the works of such composers as **PALESTRINA**, **Orlando di Lasso**, **Vittoria**, **William BYRD**, and later **J. S. BACH**.

CHURCH OF ENGLAND.

Christianity was probably brought to Britain by Roman soldiers, and by A.D. 314 there was a Church in Britain with bishops. After the pagan invasion **AUGUSTINE** came in A.D. 597, and in A.D. 673 all the English Churches united and were connected with the Roman Church, while the country was divided into dioceses and parishes. The connection with Rome was broken in 1533 by the English **REFORMATION** and the Church of England became the established Church. The Reformation ended in 1662 with the final Act of Uniformity which made compulsory the general use of the **BOOK OF COMMON PRAYER**.

The Church of England officially represents Christianity in England. It has spread to all English-speaking and many other countries. It claims that its ministry of three orders—bishops, priests and deacons—is found in the Church of the Apostles, and that they obtain their authority by unbroken succession from the Apostles. All



Lines in relation to the circle

members of the Church are called upon to believe the Apostles' Creed. The English Church gives a most important place to the **BIBLE**, which is the final authority.

CINEMATOGRAPHIC PROJECTOR, produces the illusion of movement by throwing on a screen a succession of pictures or images so rapidly that the eye blends them together into a continuous impression. The photographs which give the images are carried on a strip of film from one spool to another and are illuminated by a brilliant electric arc **LAMP**.

At the side of the film is a photographic record of the speech and other sounds accompanying the pictures, and this is turned into an electric current by an exciter lamp shining through on to a **PHOTO-ELECTRIC CELL**, the current travelling to a **LOUDSPEAKER** situated behind the screen, which gives the impression that the images on the screen are responsible for the sound.

The original photographs are taken by a special **CAMERA** which takes separate photographs very rapidly one after the other. In both the camera and the projector, the film is jerked forward by a sprocket after each photograph is

taken or projected, and a shutter passes momentarily over the lens while the film is actually moving

CIRCLE, a figure in which every point on the line that bounds it (its circumference) is the same distance from its centre. A *chord* is a straight line joining two points on the circumference. The longest chord is a *diameter*, a straight line across the circle passing through the centre. A straight line from the centre to the circumference is called a *radius* (plural *radii*)

We can show, by measuring, that the circumference is about $3\frac{1}{2}$ times the length of the diameter. There are ways of calculating this ratio

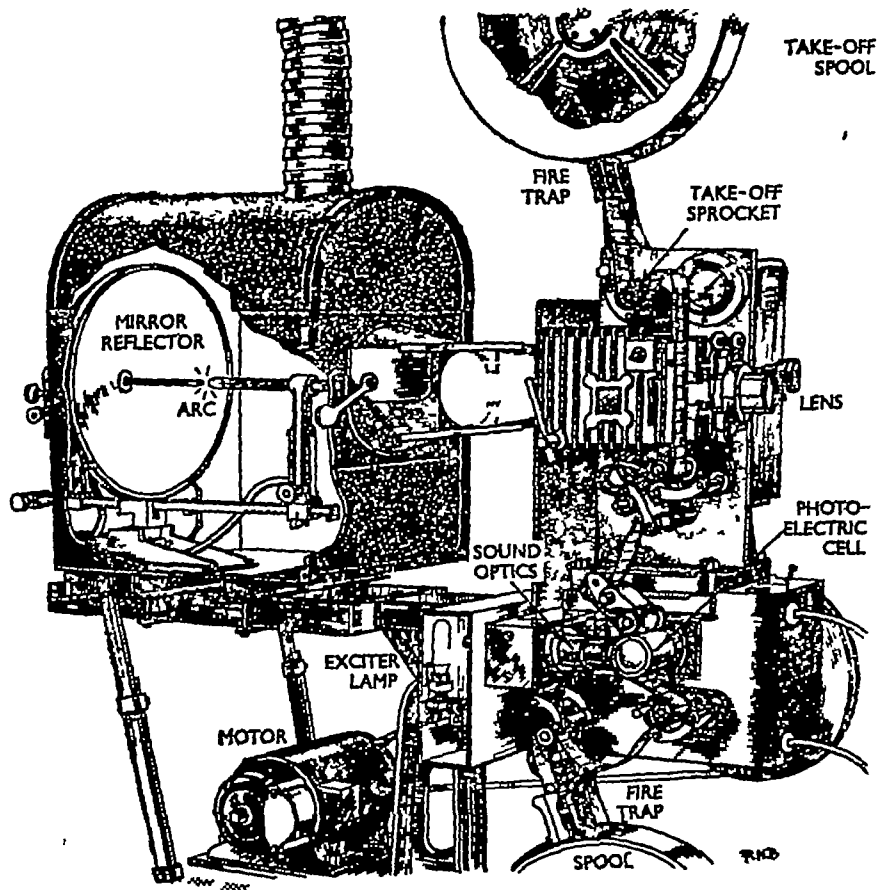
exactly, a nearly exact value is 3.1416. We often write the Greek letter π (pronounced pie) for this number

Circumference = $\pi \times$ diameter,
i.e. $c = \pi d$

A diameter is equal to two radii, so
circumference = $2\pi \times$ radius,
or $c = 2\pi r$

The area of a circle may be compared with the square on the radius. It is found that the area is equal to about $3\frac{1}{2}$ of these squares. The area of the square on the radius is $r \times r$, or r^2 . So

area of circle = πr^2
e.g. a circle of radius 4 feet has an area of $3\frac{1}{2} \times 4^2 = 50\frac{1}{2}$ sq ft



Cinematograph projector turns a strip of film into pictures and sounds

Other ways of finding the area are

diameter squared $\times \frac{\pi}{4}$,

circumference squared $\times .08$,
circumference \times half radius

A *sector* of a circle is a part enclosed by two radii and part of the circumference. Two radii divide the circle into two sectors, the smaller is the minor sector, the major sector is the remainder of the circle.

We often describe a sector by giving the angle between the two radii. A sector of 40 deg contains $\frac{40}{360} = \frac{1}{9}$ of the whole circle. If we want the area of the sector we find the area of the whole circle and then take this fraction of it.

A *segment* of a circle is enclosed between a chord and the circumference.

An *arc* is a part of the circumference.

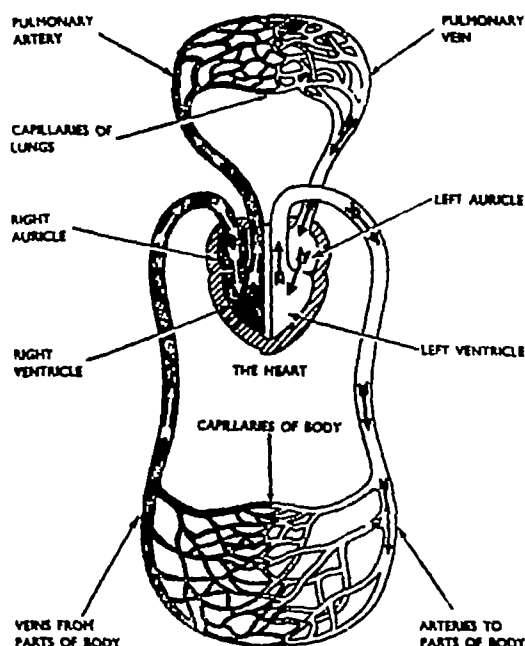
A *tangent* is a line drawn from a point outside a circle so that it touches but does not cut the circumference. The radius joined to

the point where the tangent actually touches the circle will always be at right angles to the tangent.

A *secant* is a line drawn through a circle from a point outside, cutting the circumference in two places.

CIRCUIT, ELECTRICAL, a path composed of good electricity conductors such as metal, surrounded by insulating material so that the ELECTRONS of the current do not go off in undesired directions. Thus a current can be made to pass from the point of supply through the special apparatus designed to do a particular job, then back to the supply point again.

CIRCULATION OF THE BLOOD. The heart, a muscular pump, forces blood to circulate round the body. It has two sides which work quite separately. Each has an upper part, the auricle, and a lower, the ventricle. Vessels carrying blood to the heart are veins, and away from it, arteries. Blood with fresh oxygen from the lungs enters the left auricle. This fills and contracts, causing blood to pass through a valve (preventing backflow) into the left ventricle. This is the largest, most muscular part, since it must pump blood round the body. It contracts, and the bright red blood rushes into the biggest artery, the aorta. From the aorta, branches take blood to the head, trunk and legs. Where the arteries run near the surface, as at the wrist, temple, etc., a pulse can be felt, as a wave of blood passes from the heart along the muscular walls of the arteries. Arteries divide into smaller and smaller branches, reaching every organ and muscle, until minute branches pass between layers of cells. Here the blood flows



How the blood circulates

very slowly, no pulse is felt, and the vessels are called capillaries. Through the capillaries' walls, the blood gives up food and oxygen and absorbs waste matter.

The capillaries gradually join together and form larger vessels, the veins. These unite forming bigger veins, and the blood they bring back to the heart is darker and bluer because it has lost its oxygen. A series of valves in the veins stops the slowly-moving blood from running back till it enters the right auricle of the heart.

Thence it passes through a valve to the right ventricle, which contracts to send it along the pulmonary artery to the lungs. Here it branches again to form capillaries, again, through whose walls carbon dioxide and water vapour are passed out, and oxygen taken in. The pulmonary vein returns the refreshed blood to the left auricle.

The whole double circuit takes about two minutes, and the heart beats on average about seventy-two times a minute, during which time about nine pints of blood pass through it. The rate and amount increase during exercise.

See also **BLOOD** and **RESPIRATION**.

CIVIL SERVICE, that part of government which carries into effect the laws and services decreed by Parliament. At the head of each department is a minister who is responsible to Parliament. These ministers, together with the **PRIME MINISTER**, form the government of the country. For the various government departments, see **PARLIAMENT**.

CLARINET. See **REED INSTRUMENTS**.

CLASSICAL MYTHOLOGY. The Ancient **GREEKS** had many stories about their past in which figured great heroes capable of deeds requiring terrific strength

and courage. They also had many legends to explain life, nature, good and evil, and thought that all these things were looked after by special gods and goddesses, whom they supposed to have human form and human emotions. The **ROMANS** largely accepted these Greek deities and gave them Roman names, while adding many legends of their own.

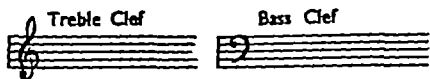
For details, see under the names of the various heroes and gods. See also **MYTHOLOGY**.

CLASSICISM in English literature arises from an appreciation of the balanced outlook of the great Greek and Roman writers, and is the spirit of sanity, of studied moderation in viewing life. It dislikes the emotional and theatrical. In **POPE** and other 18th-century writers it is the spirit of reason and common sense, a strong preference for the work and mind of civilized man over the uncouth beauties of wild nature. Compare with **ROMANTICISM**.

CLASSICS, the literature of ancient Greece and Rome. The word is also used for any literary works which by their quality have won a permanent place in literature.

CLAUSE. See **GRAMMAR** and **SYNTAX**.

CLEF, a sign placed at the beginning of a line of written music to



Fixes G

Fixes F

fix the pitch of one note and so enable the others to be estimated from it.

CLERGY are men set apart by ordination for the service of God. See **BISHOPS**, **PRIESTS** and **DEACONS**.

CLIMATE is the general or average state of the weather in a

given region Climate depends on such factors as distance from the EQUATOR, distance from the sea, slope with respect to the sun, altitude, position of mountain ranges, and the direction of prevailing winds The world can be divided roughly into the following climatic regions

(1) *Equatorial* with high temperatures and heavy rains throughout the year (e.g. Congo Basin)

(2) *Tropical* (a) Deserts with extreme heat and practically no rainfall (e.g. Sahara), (b) Savannah with high temperatures all the year round with heavy rains when the sun is overhead (e.g. between March and September in the Sudan), (c) Hot monsoon where the winters are cool and dry, and the summers hot and dry until the monsoon breaks when torrential rains occur (e.g. northern India)

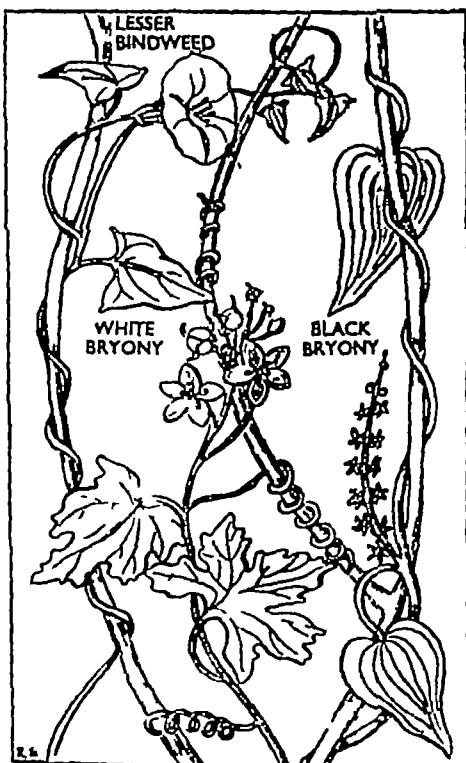
(3) *Warm temperate* (a) Mediterranean with hot, dry summers and mild, damp winters, (b) Steppes with hot summers and cold winters, with a light summer rainfall (e.g. prairies), (c) Cool monsoon similar to (2) (c) but with colder winters

(4) *Cool temperate* (a) Western margins of continents with warm summers and mild winters and rain all the year round, (b) Continental with hot summers and cold winters, and light rain in summer, (c) Eastern margins of hot summers and cold winters, with rains all the year round

(5) *Polar* low temperatures all the year round

See ATMOSPHERE, OCEAN CURRENTS, RAIN, TEMPERATURE, WINDS

CLIMBING PLANTS are those which cannot hold themselves erect, but grow upwards by using other plants, or walls, for support Some, like bindweed, black bryony, hop and runner bean have twining



Common climbing plants

stems Sweet-pea, vetches, vines and white bryony grow tendrils, which form spiral coils Old man's beard and other clematis climb actively by means of their leaf stalks which twirl round suitable supports, dog rose, bramble and goosegrass use curved prickles to help them to climb

CLIVE, Robert (1725-1774), born at Market Drayton, was sent to India to serve as a clerk in the East India Company at the age of eighteen When war broke out between the English and the French with their Indian allies, Clive was given a military command, and allowed to attack the city of Arcot (1751) He captured it but was himself besieged At last the besiegers heard rumours of the advance of more British troops and hurriedly withdrew

Clive returned home on leave and was welcomed as a hero When

he went back to India, he heard that Suraj-ud-Dowlah, the young Nawab (Indian ruler) of Bengal, had captured the Company's settlement at Calcutta. At once Clive marched his troops northward and recaptured Calcutta. The following year he defeated Suraj-ud-Dowlah at the famous Battle of Plassey (1757), and then the Empire of the Moguls (the ancient Mohammedan Emperors of India) was transferred to the East India Company, who governed it until Queen Victoria became Empress of India a century or so later.

Clive served as Governor of Bengal from 1757 to 1760, and again from 1765 to 1767. Then his health broke down and when he returned to England he was fiercely attacked in Parliament and in the Press, though Parliament in the end declared he had rendered "great and meritorious services to his country."

Warren Hastings served under Clive, and later became the first Governor-General of India (1773). He and Clive were the real founders of British rule in India. On his return to England, Warren Hastings had to face (1788) a seven years' trial for tyranny and corrup-

tion, though he had never enriched himself at the expense of the Indians, he was finally acquitted in 1795, and died in 1818 at the age of eighty-six.

CLOCK, a machine for measuring and indicating the passage of time. Most modern clocks depend upon the swinging of a **PENDULUM** or **OSCILLATION** of a balance wheel to measure out equal periods of time. But in the electric mains clock, the hands are driven by a small **ELECTRIC MOTOR** running on alternating **CURRENT** from the mains which is very accurately controlled.

CLOTHES MOTH, a minute moth (see **BUTTERFLY**) which lays eggs in woollen clothes, furs, carpets, etc. preferring dirty material. The grub-like caterpillars make holes in the stuff as they feed. Clothes moths avoid cleanliness, sunlight, and great extremes of temperature.

Stored clothes should be brushed and aired at regular intervals.

CLOUD, a body of water vapour which, owing to a drop in **TEMPERATURE**, has condensed in a collection of very small drops of liquid. These drops fall extremely slowly, so slowly that the cloud as a whole appears to move only



Cirrus clouds high in the sky



Low cumulo-nimbus cloud.

horizontally as it is pushed along by air currents

Clouds are of many forms each with a different name, but the main ones are high cirrus clouds, which are like mares' tails, stratus clouds, which appear as a uniform layer, low cumulus or heaped clouds, and nimbus clouds, which are low dense layers of dark cloud from the ragged edges of which fall rain and snow. Sometimes more than one type of cloud can be seen in the sky. Some clouds are made of two different types of cloud, e.g. cumulo-nimbus clouds.

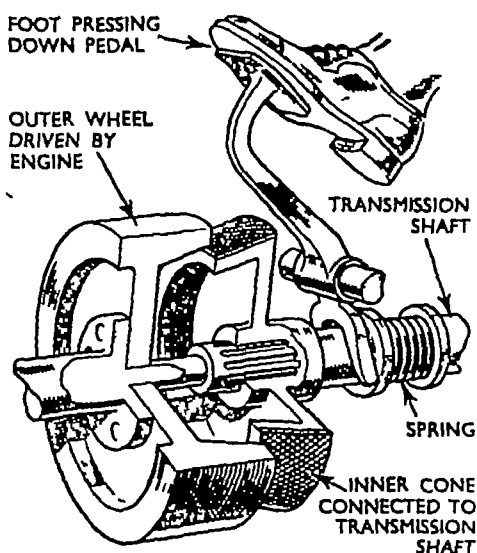
CLUTCH, part of the transmission gear of a car. It is operated by a foot pedal. When the pedal is pressed down the clutch operates to disconnect the engine from the road wheels.

The simplest kind of clutch is shown in the illustration. The inner cone, which is connected to the transmission shaft geared to the road wheels, can slide backwards and forwards on the shaft under the influence of the pedal. When the pedal is not pressed down, the inner cone is forced

by the spring into contact with the hollow conical outer wheel driven by the engine. Consequently when the two parts of the clutch are firmly forced together, the engine drives the car forward, but when the foot presses down the pedal, the inner cone is withdrawn and the engine is no longer connected to the wheels of the car.

COAL. At a time when the "trees" on the earth's surface were like huge ferns thirty or more feet tall, there were in various places great beds of fallen and decaying vegetation. The trees did not completely rot, because the water in which they fell poisoned the organisms which caused decay. After a time this rotting vegetation might be covered with successive layers of sand or even fresh vegetation, because of changes in the level of the land. With the passage of time, the pressure and heat beneath the earth's surface hardened the vegetable substance and drove off its gaseous parts, leaving us with the coal we now dig out of the ground.

COAL DISTILLATION is the process of heating coal in a closed container until it breaks up into the separate substances of which it is made. First coal gas is given off—a mixture of hydrogen and carbon compounds. With it are distilled water and ammonia which are removed. Then is formed a TAR liquid, which is subsequently distilled by itself to yield benzene, naphthalene, and pitch. Finally only coke is left, useful for boilers and for industrial purposes in which heat without smoke is wanted. The whole range of products obtained by a gas works from the distillation of coal includes among many other things the basic ingredients of aspirin, carbolic acid, dyes, and sulphuric acid.



How the foot clutch works

COAL GAS is one of the substances given off when coal is heated in a closed vessel See **COAL DISTILLATION** It is composed of hydrogen, and other gases which are either compounds of hydrogen or carbon, or compounds of carbon and oxygen, and is very poisonous It is less dense than air Its best known uses are for heating and lighting

COBRA. See **SNAKE**

COCAINE is a drug extracted from the coca plant, and used as a local **ANAESTHETIC**

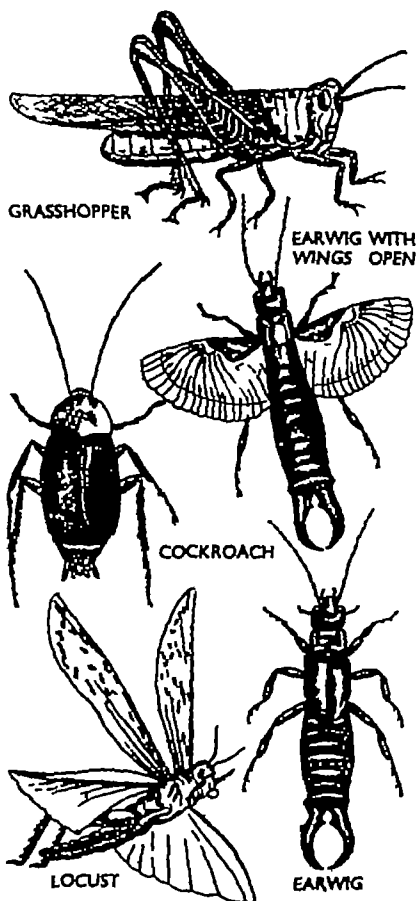
COCKATOO See **PARROT**

COCKCHAFER See **BEEBLE**

COCKLE See **MOLLUSC**

COCKROACH, a member of an **INSECT** order to which locusts, grasshoppers and earwigs also belong (though many authorities place earwigs in a separate category) Its filmy wings are folded below wing-covers Both house-crickets and cockroaches (blackbeetles) invaded England from hotter countries and so like living in warm kitchens and bakehouses Earwigs eat both flowers and harmful insects The mother shows exceptional care of the young Grasshoppers' hind legs are specially developed for leaping They "chirp" by rubbing the wing-covers together, or, in other types, against the hind leg Locusts are a terrible plague in Africa, Asia and America, devouring every leaf where they alight

CODES and **CIPHERS** are general terms used in connexion with secret writing or cryptography Today they are an essential part of the conduct of diplomatic, naval, military, aeronautical and even commercial affairs In messages connected with a country's defence measures a high degree of secrecy is necessary, especially since the advance made in electrical transmission, for it is possible for



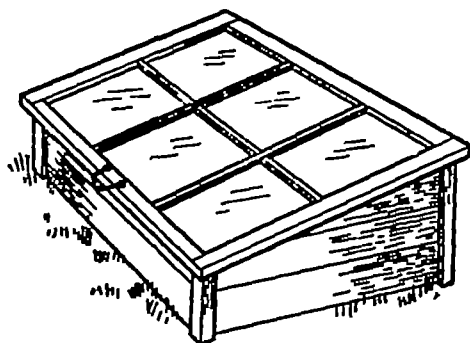
Cockroach and similar insects

messages to be picked up by receivers in the possession of those who may be potential enemies of the country In commerce, codes and ciphers are used for reasons of economy in the cost of cablegrams, etc, one word in code being often sufficient to convey a sentence

COLD, a virus infection, especially common in winter Symptoms include a sore throat, sneezing, a running nose, a cough and sometimes pain in the glands or chest, and a rise in temperature Treatment may involve staying in bed, or at least remaining indoors in an even temperature, gargling for a sore throat and inhaling for a cold

on the chest A light diet is advisable Colds can be largely prevented by keeping the general health good, and by staying away from infected people Sufferers from colds should avoid contact with other people as much as possible

COLD FRAME, a box-like structure about 6 feet long by 4 feet wide and one or more feet in height, having four wooden sides, no bottom and a sloping glass top It is used by the gardener to rear young crops earlier in the year than would be possible if they were planted in the garden without the protection of the frame The frame should be



Cold frame for vegetables

placed in a sheltered position, facing south to catch the sunshine It can be filled with mixed soil and dead leaves It is used, too, for forcing early vegetables and **HARDENING OFF** young plants grown in the **GREENHOUSE**

COLERIDGE, Samuel Taylor (1772-1834), was educated at Christ's Hospital, where his friendship with Charles Lamb began, and at Cambridge Here he met a fellow poet, Robert Southey In 1795 he married Sara Fricker, Southey marrying her sister In the same year began his fruitful friendship with **WORDSWORTH**, with whom he shared many happy hours Together they produced the *Lyrical Ballads*, an extremely original group

of poems, illustrating Wordsworth's theory that poetry should find its subjects in whatsoever may interest the heart of man, and treat these subjects, not in the rather special vocabulary used by Pope and his contemporaries, but in simple everyday words This was a new idea to the critics While Wordsworth took familiar themes, Coleridge chose ghostly subjects and then wrote about them simply and with an air of truth

Coleridge's output was not great and his poor health was made worse by his habit of taking drugs His poetic fame rests chiefly on a few remarkable works, *The Rime of the Ancient Mariner*, and the unfinished *Christabel* and *Kubla Khan* He did valuable work in criticism, believing that poetry should give pleasure by its beauty He interpreted the work of German thinkers, and was interested in political thought, being an admirer of **BURKE**

COLLINS, William Wilkie (1824-1889), was a barrister who turned writer, a friend of Charles Dickens, and the inventor of the first professional detective in English fiction His novels, *The Woman in White* and *The Moonstone*, though long-winded by modern standards, are first-rate mysteries and still widely read

COLLOID. A substance is said to be in a colloidal state when it is split up into particles which, while not dissolved in the liquid in which the colloid is suspended, nevertheless owing to their tiny size remain in suspension indefinitely This effect is also aided by the electrical condition of the particles. Examples of common colloids are starch, glue, and egg-white Certain colloidal metals are used nowadays in medicine.

COLOMBIA is a South American state south of the Isthmus of

Panama, lying at the end of the Andes and consists mainly of three mountain ranges. Most of the people live on the eastern plateau. The extensive forests in the south provide all kinds of timber, especially mahogany, and coffee, cotton and some tobacco and cereals are grown. Gold, silver, platinum, copper and emeralds are mined, but the greatest wealth is in the oil-fields. The chief towns are Medellin and the capital, Bogota. See map of SOUTH AMERICA.

COLONY, a settlement of people who have emigrated from their native country to some comparatively unpopulated region where they may build a home and life for themselves without severing connexion with the mother country. The earliest colonies we read of were those of the Phoenicians and Greeks on the shores of the Mediterranean. Among modern nations colonization began in the 17th century and many European countries, Britain, France, Holland, Belgium, Spain, and Portugal have colonies scattered throughout the world. See **BRITISH COMMONWEALTH OF NATIONS**.

COLOUR. All colour is brought about by **LIGHT**, and without light we would have no colour. White light, i.e. sunlight, is composed of all the colours put together, and the reason we see different colours is because each surface receiving light absorbs some of the colours and throws back or reflects the others to our eyes. For instance, a red flower takes in all the colours but red and reflects red to be seen by the **EYE**. White flowers absorb no colour, so we get the reflection of all—an impression of white. Black objects absorb all colours, so that black is really not a colour but absence of colour.

We can split up white light into its various hues by passing a beam

of light through a glass prism. No doubt you have seen this happen in your own home, when a beam of sunlight passes through a cut glass salt cellar or a similar object, you see on the wall opposite a patch of colour which you can divide up into the colours which make up white light. This is called the **SPECTRUM**. The same is seen in the **RAINBOW**.

COLOUR BLINDNESS is inability to distinguish between certain colours, especially green and red. In extreme cases all colours appear grey. Colour blindness is inherited (see **HEREDITY**), and is much more common in men than in women.

COLUMBA, St (A.D. 521-597), was an Irish saint who settled on the island of Iona, off the west coast of Scotland, in 563. Here he built a church and monastery, and undertook the conversion of the Picts, setting up many monasteries in northern Scotland.

COMET, a body moving around the sun. It has a bright head and a fainter nebulous tail which is always turned away from the sun.

COMMERCE or trade, the exchange of goods, has to a large extent created our civilization. At first, man is self-sufficient, that is, he lives from the produce of his work. His wants are simple. He hunts, fishes, gathers berries and food and consumes them. But as he produces more, he finds he has a surplus and instead of wasting it, he exchanges it for other goods that he needs, but cannot produce himself.

In early England under the **FEUDAL SYSTEM** the Manors were self-sufficient units. The inhabitants lived from the produce of the Manor. And the more self-sufficient people were, the lower was their standard of living. But as living standards rose, so exchange or commerce increased. For long Britain

has been one of the great shopkeepers of the world, and her goods are made for the world market. One of her problems today, indeed, is that she has ceased to live on her own, ceased to feed herself the food grown at home is not sufficient. Britain is dependent on the cornfields and cattle ranches of other parts of the world for much of the bread and meat, butter and bacon required at home. She exchanges manufactured goods for food. This exchange is part of the trade of the world. Thus, goods manufactured in Britain are exchanged for tropical products such as rubber and oil, on which present standards of living increasingly depend. Commerce unites peoples in bonds of mutual advantages. One country wants cocoa, let us say, from the Gold Coast where it is plentiful. So it is exchanged for bicycles. And both countries gain.

An essential for commerce is good communications along which goods can be carried. For internal commerce we have roads and railways. For external commerce there are ocean highways, traversed by the tramp steamer, and airways, traversed by the cargo plane. See **TRANSPORT**.

MONEY makes this exchange of goods and services possible.

Producers of food and raw material sell their products to the **MANUFACTURERS**. Manufacturers make up their goods and sell them to the **WHOLESALE**RS, who sell them to the **RETAILERS**, and the retailers sell them to the public, the final consumers, who are thus able to obtain their daily needs. So we wear boots made from leather "grown" in the Argentine, and clothes made from wool "grown" in Australia. Even our food has become a symbol of the commerce and the interdependence of the world.

COMMUNISM is a name given to the political theory which holds that all property, in the sense of mines, factories and land—the sources of wealth and the means of production—at present owned by a small fraction of the populace, should be communally owned, as technical progress is now such that it requires whole communities or large assemblies of men to use the "tools." The social organization of labour in vast undertakings (already largely achieved) should be logically followed, it is argued, by the social ownership and control of these undertakings and of what they produce. Further, communists hold that each member of the community should work to his full capacity and receive back from the common pool what he needs. Thus far communism is largely in agreement with **SOCIALISM**. But communists believe that the political power necessary to bring about this change must be literally fought for by the working class, who would then have to establish a dictatorship expressed through the Communist Party. The main support for this theory comes from a very detailed description of the historical development of private enterprise or capitalism made by Karl Marx, a German Jew, in his book *Capital*.

Socialists, on the other hand, believe that the change can be brought about through a parliamentary victory which yet preserves normal democratic liberties for all.

In Russia **LENIN** and the **Bolsheviks**, a Marxist political party, seized power in 1917, and proceeded to remodel the state as the first step towards a communist society.

COMPANY. A business may be either a one-man concern, a **PARTNERSHIP**, an unlimited company, where the shareholders are responsible for all the debts of the

company, a private limited company, or a public limited company. The word "limited" means that the financial obligations of each person owning SHARES in the company is limited to the value of those shares, and no further calls can be made upon the shareholder if the limited company should fail.

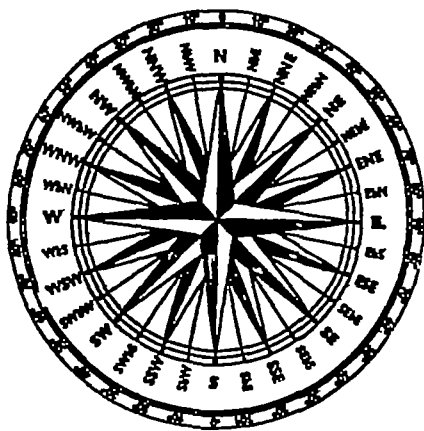
In the case of a private limited company, the shares are held by not less than two and not more than fifty people, and the public generally is not asked to subscribe.

When a limited company appeals to the public for CAPITAL, for the public to buy shares in that company, then that company is a public limited company.

In order to prevent fraud, the formation of public limited companies is regulated by law. At least seven persons must combine to form such a company. They must register the company with the Registrar of Joint Stock Companies, and give details of (1) the name of the company (they can take any name they please), (2) their registered office, (3) the objects of the company, (4) the capital of the company, (5) a declaration that the liability of the members is limited. These details are given in a Memorandum of Association. When the company is registered, the Directors issue a Prospectus to the public in which they give details of the proposed business of the company and ask the public to subscribe for shares.

Thus, a company seeking capital can draw on the savings of thousands of investors all over the country. For many large concerns this is the only method of raising the necessary capital to finance them. An investor need not put all his money into one company. And if he needs money he can sell his shares, perhaps on the STOCK EXCHANGE.

COMPASS, an instrument used for direction-finding. It is based on the fact that if a magnetized needle is balanced at its centre it will turn until its ends (or "poles") point roughly towards the North and South Poles of the earth. The exact place to which the North Pole of a magnetized needle points is in the north of Canada, and is known as the North Magnetic Pole. From



Points of the compass

Britain it was about $9\frac{1}{2}$ degrees west of True North in 1947, but it is gradually getting nearer to True North year by year.

A practical form of the compass consists of a magnetized needle balanced so as to rotate freely and point towards the North Magnetic Pole. Underneath is a marked card indicating North, South, East, and West, etc. and perhaps the degrees as well. We hold the compass steady, so that the needle comes to rest. Then we turn the compass until the point $9\frac{1}{2}$ degrees west of North, i.e. about midway between North (N) and North north-west (NNW), is now under the North Pole of the needle. From the card we can then truly reckon all the directions around us. Compasses are essential to navigate ships and

aircraft, and special compasses have been devised to allow for tilting movements at sea or in the air
See **GYROSCOPE**

COMPOST, a mixture of different types of earth in proportions found to further plant growth

The materials required for them are quite easy to obtain They are (1) *Loam*—ordinary good soil, the top spit of a pasture stacked and rotted down (2) *Sand*—sharp and clean with a good proportion of coarse particles (3) *Peat*—obtainable from most seedsmen For *Seed Compost* you need 2 parts Loam, 1 part Sand, 1 part Peat, for *Potting Compost*, 7 parts Loam, 2 parts Sand, 3 parts Peat

COMPOST HEAP. In a garden valuable plant food can be made from rotted remains of plant material, such as lawn mowings and weeds These are left to decay in a heap or pit, and later used as

manure The rotting process is sometimes speeded up by the addition of suitable chemicals

COMPOUNDS See **MIXTURES AND COMPOUNDS**

CONCERT really means the making of music together Now the word is used for music performed before a gathering of people

CONCERTINA. See **REED INSTRUMENTS**

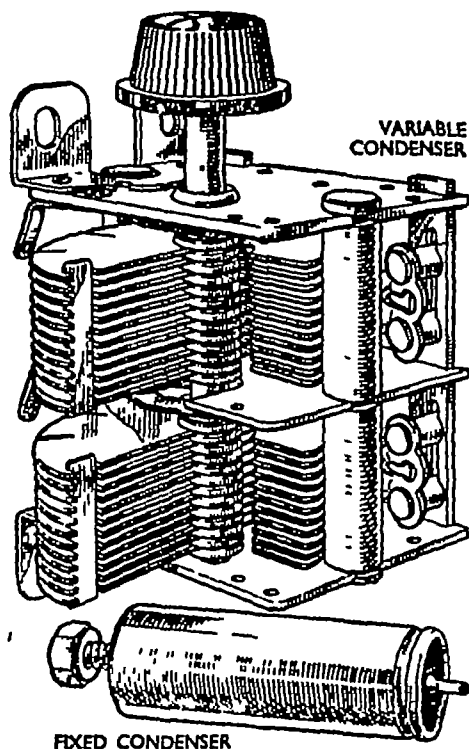
CONCERTO. See **FORM IN MUSIC**

CONCRETE is a building material made from gravel or granite chips, sand and Portland **CEMENT** The materials are thoroughly mixed and then well wetted until a sloppy mixture is produced This is poured into any required mould, where it sets hard If greater strength is required, as in roads or bridges, steel rods or wires are put in place and the concrete is formed around them This is called reinforced concrete

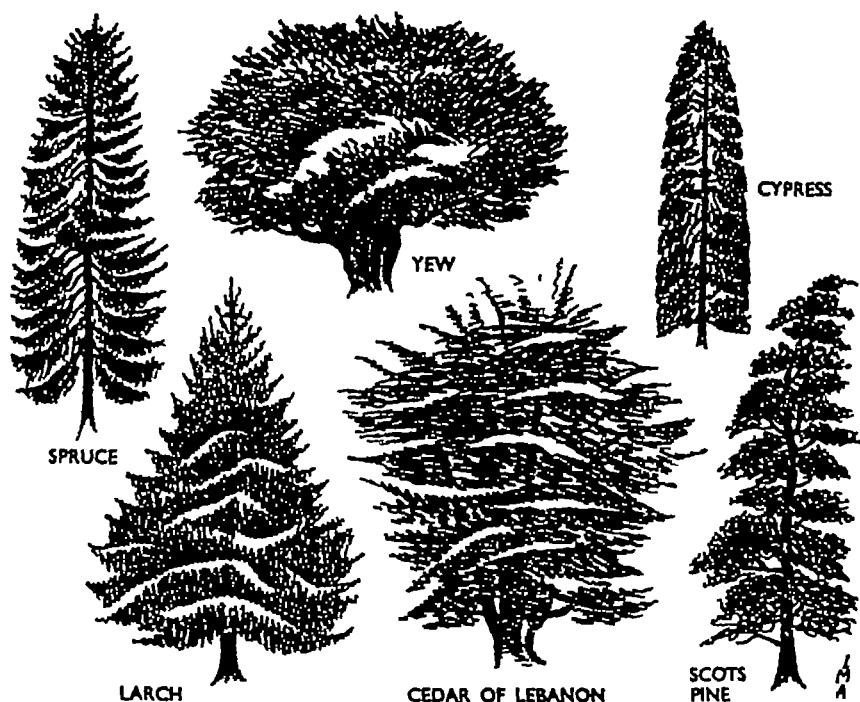
CONDENSER. An *electrical* fixed condenser consists simply of two metal surfaces with insulating material separating them The metal surfaces are at different voltages, and the effect is to accumulate positive and negative charges and store them up

Variable condensers have two sets of plates, one set fixed, the other moving, and hold different quantities of charge according to the area of the plates which overlap They are used a great deal in wireless sets for tuning purposes

A *steam* condenser is an arrangement of pipes through which the exhaust steam from an engine passes The pipes are cooled by cold water flowing round them, and the steam therefore condenses (i.e. turns to water) inside the pipes and reduces the back pressure in the cylinder See **ENGINE** The water in the pipes is then pumped out, and



Condensers used in wireless



Here are some comfers that are to be found in Britain

may be sent back to the boiler to be used again

CONE. See **MENSURATION**

CONFIRMATION is a rite which completes baptism in some Christian Churches. It was first used by the Apostles. In confirmation the baptismal vows are renewed, and the gift of the Holy Spirit is received. Those confirmed are usually about the age of twelve.

CONFUCIUS (551-478 B.C.), was a wise Chinese whose chief aim was to increase the welfare of the state. Rulers, he said, must be interested in their people, who would then be loyal. As a teacher he held that the good and wise man is sincere, kind and reverent to others. His sayings form the basis of the great books of China, where in every town there is a temple in his memory.

CONGREGATIONAL CHURCH, started about 1570, its

members being called Independents for many years. Congregationalists believe that each congregation (or group of Christians in any place) should manage its own affairs, they do not have bishops, creeds or prayer books.

CONGRESS is the Parliament of the U.S.A. It consists of two houses, the Senate and the House of Representatives. They are both elected bodies.

The executive power is in the hands of the President who is elected for a period of four years. He is then eligible for re-election.

CONGREVE, William (1670-1729), great master of satiric comedy, making play with the absurdities of the fashionable world. Revivals of his plays are much relished, especially *Love for Love*, and *The Way of the World*.

CONIFERS are trees or shrubs

which bear cones and are often evergreen The SEEDS are not enclosed in an OVARY, but exposed as the cones ripen and open The Scotch fir, cedar, pine and spruce are EVERGREEN, the larch a DECIDUOUS conifer Most conifers grow rapidly, and some attain a great height, such as the redwood trees of California Their straight supple stems make them suitable for masts and flag-staffs

CONJUNCTION. See GRAMMAR

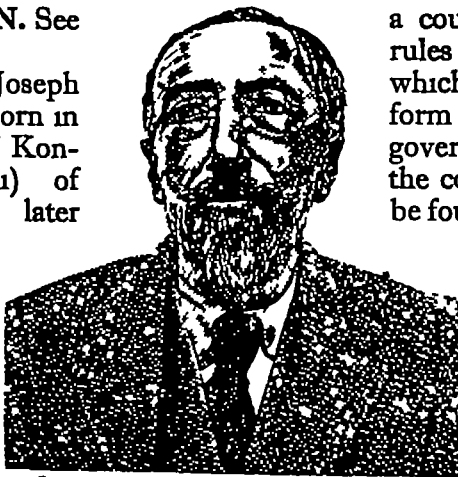
CONRAD, Joseph (1857-1924), was born in the Ukraine (Josef Konrad Korzeniowski) of Polish parents, later exiled for revolutionary activities He was at school in Cracow, and in 1874 started to satisfy his ambition to become a sailor In 1884 he became a naturalized British subject and held a Master's certificate from the Board of Trade He left the merchant service in 1894, to devote himself to writing novels in his adopted tongue

Conrad has a permanent place in English literature No one has better described the struggle which sailors wage with the sea—*Typhoon*, *The Nigger of the Narcissus* and *Youth*, or the richness and splendour of tropic nights in the Far East—*Almayer's Folly* and *Lord Jim* He is also, however, a deep student of character and is impressed in a romantic way with the loneliness and isolation of every man and with those deeds and traits and motives which set each individual apart from his fellows

CONSCRIPTION is compulsory

military service, for a limited period, varying in different countries, in order to train sufficient people in peacetime to form the armed forces in time of war Britain preferred the system of voluntary enlistment, but introduced compulsory service in war both for military and industrial needs

CONSERVATISM. See **TORIES** AND **WHIGS**



Conrad, writer of sea-stories

CONSTITUTION (of a country), the body of rules and regulations which determine the form and manner of government In Britain the constitution is not to be found in a single document but is laid down by various Acts, and in many points is a matter of accepted practice or precedent In the U S A the constitution is an agreed document which defines the powers of the **FEDERAL GOVERNMENT** and the powers reserved to the several States Most countries of the world have a written document setting out their form of government

CONSUMER GOODS. See **CONSUMPTION GOODS**

CONSUMPTION is the process of using things up Everything that you buy you use up or consume Thus you drink your tea, you light a match, you burn coal, you wear a pair of gloves Such goods as these are consumed quickly Other goods are consumed slowly—a girl's doll, a boy's engineering set, a football, an armchair. But eventually all goods are consumed or used up

PRODUCTION creates goods for consumption Because consumption goes on all the time, production, too,

has to be continuous See **CONSUMPTION GOODS** and **PRODUCTION GOODS**

CONSUMPTION GOODS are those goods that are used up, or consumed, quickly and therefore need to be continuously replaced After every war, there is an unusually great demand for consumption goods The reason is that during the war factories and foundries were all producing weapons and war materials, so that people had to make their old things last longer As they wear out, or get used up, there develops a great shortage of such everyday consumption goods as furniture and clothes, food and fuel During the Second World War, 1939-1945, everyday consumption goods were rationed By rationing such goods were distributed fairly and not according to capacity to buy See **CONSUMPTION** and **PRODUCTION**

CONTINENT, a great land mass such as **EUROPE**, **ASIA**, **AFRICA**, **NORTH AMERICA** and **SOUTH AMERICA** and **AUSTRALIA**

CONTRACT, a promise which the law will enforce A contract may be one of two kinds (1) a simple or implied contract, or (2) a contract under seal For example, you stop a taxi in the street and get in Here is an implied contract The taxi-driver offered to carry you You offered to pay for that service You must both keep that contract

Any contract for the sale of goods to the value of £10 and upwards must be in writing, signed, and the proper stamp affixed it becomes an agreement, which the law will enforce (Between two persons who know each other well, business deals may be verbal If, however, one party breaks his promise, there is no remedy in law) When a contract is signed and stamped it becomes a legal docu-

ment If one breaks the contract, then the law will punish him

There are some contracts that the law will not accept The law will not enforce a gambling contract If you gamble and lose, the winner cannot make you pay your gaming debt by suing you in a law court If you sign a contract by misrepresentation, then you, as the person deceived, need not carry out the contract, and the law will uphold your action

CONVECTION See **RADIATOR**
CONVENT, a community of people, monks or nuns, who live together to serve God by worship and work The name is also given to a building housing a community of nuns

CONVERSION, in religion, is a change of heart resulting in the acceptance of religion or in the adoption of a new faith The most famous Christian conversion is that of St PAUL on the road to Damascus

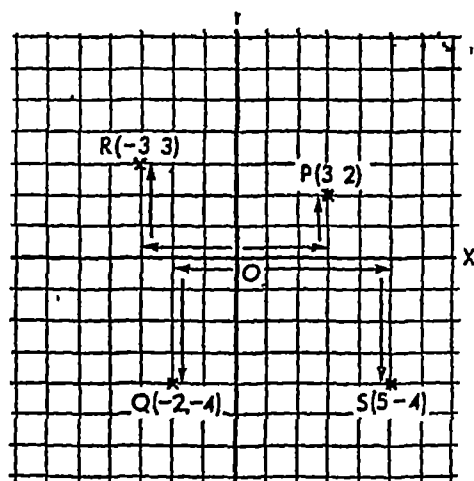
CO-OPERATIVE Whenever people arrange to create a business, they are being co-operative In this sense even a Joint Stock COMPANY is a co-operative, because the shareholders co-operate to form the company But co-operative has acquired a specialized meaning from the experiment begun in 1844, when a few workmen in Rochdale, Lancashire, combined their savings and opened a store They decided to sell their goods at the same price as other shops but to divide the profits not among themselves but among the customers in proportion to the amount of money they spent in the shop So began Consumers' Co-operatives This experiment proved a success and Consumers' Co-operative Societies have been formed to sell all sorts of goods, and have been copied abroad

The principle has remained the same An investor can buy shares

in the Co-op, as the Co-operative Society is called, and on these he receives interest. A housewife buys her goods at the Co-op Half-yearly, or yearly, the Co-op makes up its accounts. After paying all expenses, it divides the remaining profit among the purchasers, and the housewife will receive a share according to the amount of money she has spent at the store. This is called the Dividend.

The majority of Co-op stores are retail shops, they sell direct to the consumer and in small quantities. These Co-op stores have themselves co-operated, to buy wholesale through a Co-operative Wholesale Society on the same principle. The retail Co-op stores receive a dividend in proportion to their purchases from the Co-operative Wholesale Society. There are also Producers' Co-operative Societies in which the workers are the shareholders and therefore the owners of the business, so that profits go back to the worker-owners. They receive their wages, then when the business makes up its accounts, profits are distributed to the shareholders, i.e. to the workers in the business. Because the workers are also the owners, they can give themselves the best conditions of employment. Nowadays the principle of co-operation is being extended to other aspects of commercial life, to banking, to dairy farming, to agriculture, to hotel-keeping. Many support these co-operative societies because they believe that co-operation is better than competition.

CO-ORDINATE GEOMETRY is a method of representing position by means of algebraic values. We begin with two lines (axes), crossing at right angles. The horizontal x axis is called the abscissa, the vertical y axis is the ordinate.



Position represented by values

Measurements start at O (the origin or zero point). The first + measurements are made to the right from O , and - measurements to the left. The second + measurements are measured up from O , and - measurements down.

$(3, 2)$ is a point where $x = 3$, $y = 2$. We go 3 units to the right from O , then 2 units up. P is $(3, 2)$. $(-2, -4)$ is a point where $x = -2$, $y = -4$. We go 2 units to the left from O , and 4 units down. Q is $(-2, -4)$.

Similarly S is $(5, -4)$, and R is $(-3, 3)$.

Any first degree equation (containing only x , y and numbers, not x^2 , xy , y^2 , etc) can be represented by a straight line, whose position we fix by determining two points and joining them. See also GRAPHS.

COPERNICUS, Nicolaus (1473-1543), the great astronomer, was a native of Poland. He studied at the Universities of Cracow, Bologna and Padua, especially astronomy, mathematics, medicine and theology.

As an astronomer, Copernicus had studied the philosophy of the Ancients, but was not convinced that their conclusions concerning the heavenly bodies were always

correct, so he set himself the task of independent investigation. Few instruments existed, and those which were available were very crude. Yet, it was not long before he had established the fact that the sun and not the earth was the centre about which the planets, and also the earth as one of the planets, revolved. Obviously, this was a great and revolutionary astronomical discovery, since before that time it had been believed that the sun revolved around the earth and not the earth around the sun. Copernicus did not, however, make his discovery known, except to a few of his friends. He knew well that many would be sceptical. It was not until he was fifty-seven that those who had confidence in him prevailed upon him to allow his work to become known; it produced a controversy that lasted for many years. Instead of endeavouring to estimate the value of his conclusions for themselves, many people were content merely to adhere unquestioningly to



Coral in the Sea

the beliefs of the Ancients.

Apart from the great work he did in ASTRONOMY he gave an impetus to scientific investigation. Well might he be called the "Father of Modern Astronomy," for following him were Tycho Brahe, Kepler, and Galileo, all providing proof of this theory, so that today what is known as the "Copernican System" is accepted by all scientists.

COPPER is a red, ductile metal which is a good conductor of both heat and electricity. Many alloys are made from it, the most common being brass and bronze.

COPYRIGHT is the right of protection which the law gives to an author, a composer, a film producer, etc., against persons copying or publishing in whole or in part his books, or using in public plays, songs, musical compositions, or films, without permission. The protection lasts for the period of the author's lifetime and for fifty years after his death. See **MONOPOLY**.

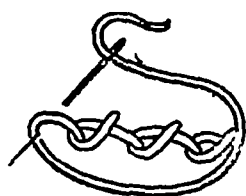
CORAL, a tiny animal related to the SEA-ANEMONE and JELLYFISH, and closely resembling the former, although very much smaller. They exist in united colonies, and they extract lime salts from the sea, forming them into a stony skeleton. The living part continually grows upwards, the remaining skeleton below eventually forming coral rock. See **ATOLL**, **CORAL REEF**.

Red coral, used for ornament, is not a reef-builder, and grows in the Mediterranean.

CORAL REEF, a ridge of coral rock which may be anything up to 1,000 miles long found in shallow waters off the shores of islands and continents in tropical regions. Fringing reefs are close to the shore, barrier reefs are farther out. The coral polyp is a minute sea animal which lives in a rock-like

skeleton made by extracting lime from sea water. Coral rock is made up of millions of these skeletons and varies greatly in form and colour. Coral formations are found chiefly in the Pacific, Indian and Atlantic Oceans. The longest reef is the Great Barrier Reef off the north-east coast of AUSTRALIA. See also ATOLL.

CORAL STITCH. To make this stitch, work from right to left, bringing the needle through at the end of the line to be covered. Holding the thread down with the left thumb, take up a portion of the



Coral stitch

material with the needle at an angle to the line and under the held thread, and pull it through over the working thread. This is a useful outline stitch, which is quickly worked. The illustration shows the method of working the knots, of course, should be drawn tight.

CORM, an underground stem which, like the BULB, stores food for the young plant. It also has the power of reproducing itself. Examples are crocus and gladiolus.

CORNET, a musical instrument somewhat like the TRUMPET in general appearance, design and operation, but capable of being played with greater ease, so that rapid passages can be performed on it. The cornet forms part of brass and military BANDS. See picture on page 405.

COROLLA. See FLOWER.

CORONA, the halo seen around the sun during a total eclipse, or around any electrical conductor at a very high voltage. In the latter case it is caused by electricity escaping to the air.

CORONER, the official—a barrister or doctor trained in the law—whose duty it is to make inquiry into the death of any person who may have died from other than natural causes. His inquiry is known as an *inquest*.

CORROSION is the eating away of a surface which is exposed to the action of a chemical agent, as when an iron nail is rusted by the water in the atmosphere.

CORRUGATED IRON, sheet iron dipped into zinc and bent into wave-like ridges. It is much used in building.

CORSICA is a mountainous island off the south coast of France, with a narrow coastal plain. It belongs to France. Much of the surface is uncultivated forest. Citrus fruits and grapes are grown in the lowlands, and the chief industry is the canning of fish and other food. Some salt and antimony are produced. The chief towns are Ajaccio, the capital, and Bastia.

See the map of ITALY, near which it lies.

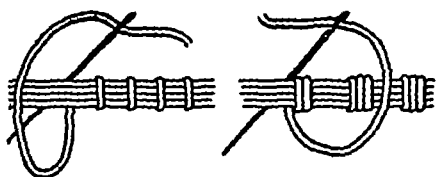
COSTA RICA is a small republic of Central America. The capital is San José. Its products include coffee, bananas and cocoa. See map of CENTRAL AMERICA.

COSTUME. Throughout the ages, men and women have continually changed the style of the clothes they wear to keep pace with new materials and new ways of life. The desire for novelty or distinction has also played a part.

COTYLEDON. See SEED.

COUCHING. A simple method is shown in the first example, where a group of threads is held down to a foundation material by a single thread. The second example shows a variation of this, with groups of three stitches worked at regular intervals to give a more decorative effect to the couching.

The threads which are being couched should not pucker and the couching stitch should be firm



Two ways of couching

COUNTERPOINT is the art of combining two or more tunes in such a way that, though they are interesting melodies in themselves, they also unite to form an harmonious whole

COUNTY COUNCIL See **LOCAL GOVERNMENT**

COVENANT is a word for a bond or agreement **JEREMIAH** wrote about the new covenant God would make Jesus said at the Last Supper that by His Death God would make a new covenant "This is my blood of the New Testament"

"In this context the word testament means the same as covenant

COVENANTERS are the Scottish Presbyterians who fought in the 17th century to uphold the Presbyterian faith against episcopacy, rule by Bishops

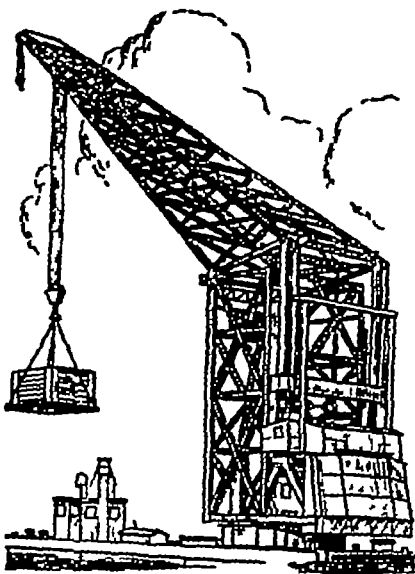
COWPER, William (1731-1800), English poet, early developed a melancholy disposition which afflicted his whole life

In 1765 he went to live with the Unwin family in Huntingdon, going to Olney on the death of the husband Here he met Newton, the curate of Olney, who turned him to hymn-writing The Olney Hymns (published 1779) include "God Moves in a Mysterious Way" and "Hark, My Soul! it is the Lord" Newton's influence, however, led to acute religious mania in 1773, but in 1779 Cowper recovered, and a peaceful period followed in which

he wrote some of his most attractive work, including "John Gilpin" and "The Task," a long poem on rural life and home pleasures In 1786 he moved to Weston Underwood, where he wrote some short poems, including "On the Loss of the Royal George," and the poem to Mrs Unwin, "To Mary" Mrs Unwin, who had been his life-long friend, died in 1796, and Cowper survived her by only four years He left delightful letters, full of amusing village gossip

CRAB. See **CRUSTACEANS**

CRANE, an appliance capable of lifting a heavy or cumbrous object out of one place and depositing it in another, much used in engineering works and in connexion with the shipping of goods and cargoes The commonest type has a stiff arm or jib, at its upper end there is a pulley through which runs a rope, one end of which is fixed to the load, which can then be lifted from the ground by the action of the windlass at the other end of the



Large crane at the docks

rope The arm of the crane is then raised or lowered and the whole crane itself turned, thus enabling the load to be swung to the desired spot and there deposited In some cases the crane can travel along to

creatures, and finally man, in six days, and on the seventh day He rested

CREDIT. See **BOOK-KEEPING**

CREED is a statement of belief The oldest creeds of the Christian



Artist's conception of the Creation God and the first creatures

wherever it is needed for lifting goods and materials

CRANMER, Thomas (1489-1556), became Archbishop of Canterbury in 1533 and worked with Henry VIII in his religious reforms He was principally responsible for the compiling of the Book of Common Prayer (see **PRAYER BOOK**) On the death of Henry, when Queen Mary restored the earlier religious beliefs and customs, Cranmer tried to compromise with his previous reforming principles, but in the end, after a temporary weakness, he met a martyr's death, as had Ridley and **LATIMER** before him

CRAYFISH See **CRUSTACEANS**

CREATION, THE In Christian belief, God created the world In the Bible, the book of Genesis contains the story of the Creation God made night and day, water and land, sun, moon and stars, living

Churches are the Apostles' Creed, the Nicene Creed, and the Athanasian Creed, all written before A.D. 600 to correct wrong teaching, and for the confession of faith at baptism

CRICKET is one of the main national games of England It is now played in many other countries all over the world.

A match is played between two sides of eleven players each, one side batting, one fielding The diagram shows some of the positions of the fielders, but there are others, e.g. Forward Short Leg, between the batsman and Mid-on, 3rd Slip, to the right of the 2nd Slip, Gulley, to the left of Point, Silly Point, between the batsman and Cover Point, 3rd Man, behind 2nd Slip, Long Leg, behind Fine Leg, Deep Field, usually behind the bowler, Long-off, behind Mid-off,

Extra Cover, between Cover Point and Mid-off

A fielder may be moved to different positions according to the discretion of the bowler or captain

The game is played with a leather-covered hard ball weighing $5\frac{1}{2}$ to $5\frac{3}{4}$ ounces and just under 9 inches in circumference, a new one may be demanded by either side after 200 runs have been scored or at the beginning of an innings. The bats are made usually of willow, grown specially for that purpose

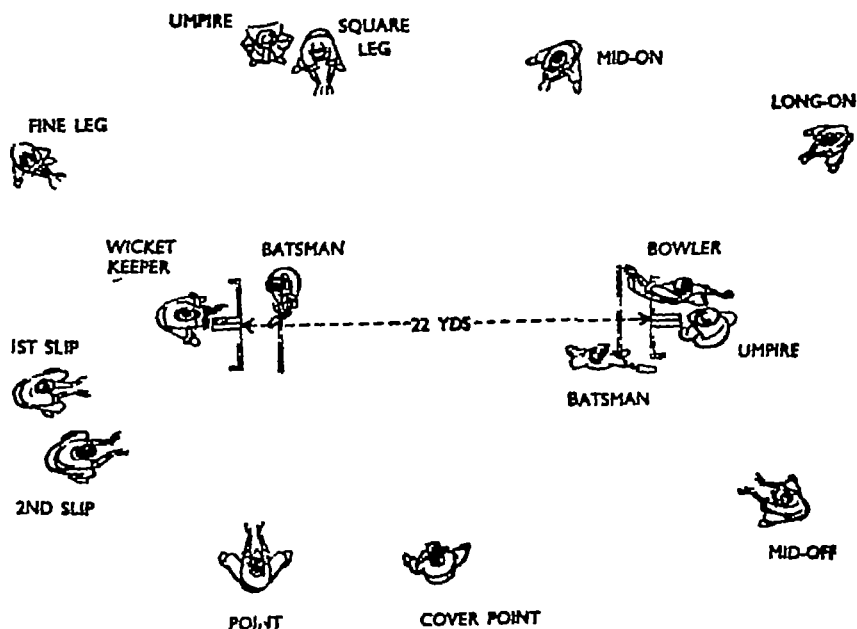
The wickets, 27 inches high and 8 inches in width, are each of three stumps with small pieces of wood called bails lying on the top

The pitch, or ground, between the two wickets measures 22 yards and must be absolutely smooth, in order not to deflect the ball

The bowler, who may not throw or jerk the ball, bowls to hit the wicket and dislodge the bails, and the batsman tries to prevent his

doing this and also to hit the ball out of the way of any fielders, so that he can run between the wickets. The side with the greatest number of runs at the end of the game wins (A run is scored when each batsman has run to the opposite wicket). The batsmen go in in turn, and when there are so many of them out that there are not two men left to man the wickets, the side is out and the innings is over. A side may "declare," i.e. end the innings voluntarily, at any state of its score. Each side has two innings in the normal game, but single-innings matches may be played

There are two umpires, one for each end of the pitch, they see that the rules are obeyed, especially (1) the bowler must have one foot on the ground *behind* the bowling crease when delivering the ball, if not, the umpire calls "no ball" and the batsman cannot be "out", (2) the ball must not reach the batsman



Typical position of cricket fielders for a slow bowler

too high or too far to either side or it is a "wide," and scores one run for the batting side

The bowler is allowed six balls (an "over") after which he passes the ball to another fielder who bowls from the opposite end

A batsman may be out if he is

(1) Caught out—a fielder has caught the ball after it is hit, and before it touches the ground

(2) Bowled—the ball hits the wicket, dislodging one or both bails

(3) Stumped—the batsman is out of his crease after missing the ball while striking and the wicket-keeper knocks off a bail with the ball in his hands

(4) L b w (leg before wicket)—the batsman puts his body in the way of a ball pitched between the

wickets, which the umpire considers would have hit the wicket

(5) Hit wicket—when attempting to strike the ball, the batsman knocks down his own wicket

(6) Obstructing the field—the batsman purposely does something to prevent a ball being caught or fielded

(7) Run out—the batsmen have left their wickets for a run, and a wicket is struck down with the ball by a fielder before a batsman reaches it

When two running batsmen have crossed each other and the wicket is struck down, the man is out who was running to it, but if they have not crossed when the wicket is struck then the one who has left the wicket which is struck down is



Charge of the Light Brigade during the Crimean War

out A run is not counted if the striker is caught or run out while making it

A ball hit to the boundary counts as four runs, if it first touches the ground outside the boundary it is six runs One hundred runs by one man is called a century and no runs made is called a duck

CRIMEAN WAR (1854-1856), the result of Russian attempts to interfere with the affairs of Turkey The Turkish Empire in Europe then included the Balkan Peninsula, inhabited by a medley of races who were Christians (members of the Greek Church) while the Turks were Moslems The Russians, also members of the Greek Church, claimed the right to protect their fellow Christians, but Britain and France suspected Russia of wishing to extend her territory along the Danube, occupy Constantinople and so threaten the route to India and the East When Russia went to war with Turkey, Britain and France agreed to help the Turks The war was fought mainly in the Crimean Peninsula of the Black Sea, in south Russia

The chief events were the siege of Sebastopol and the battles of Alma, Inkerman and Balacava Balacava is famous for the gallant charge of the Light Brigade, when owing to mistaken orders "the gallant six hundred" rode "into the valley of death" to take a few Russian guns, and for the charge of the Heavy Brigade which broke up the Russian cavalry on the same day

Sebastopol was taken by the Allies, and the war ended with the Peace of Paris (1856)

More important to mankind than the efforts of military leaders was the brave, self-sacrificing work of Florence Nightingale Shocked by the terrible stories of neglect and



The Lady with the Lamp

mismanagement in the military hospitals, she went to the battle zone at the head of a small band of nurses Under her masterful organization, the hospitals were speedily reformed, and the patients became clean and comfortable instead of lying for days in the blood-stained, muddy garments of the battlefield She always went round the wards the last thing at night, and the soldiers called her "the Lady with the Lamp" On her return to England the sum of £50,000 was subscribed, and with it she set up schools for training nurses She lived to see the work of sick-nursing raised from a despised calling in the hands of ill-trained women to a great and scientific profession

She died in 1910 at the age of ninety

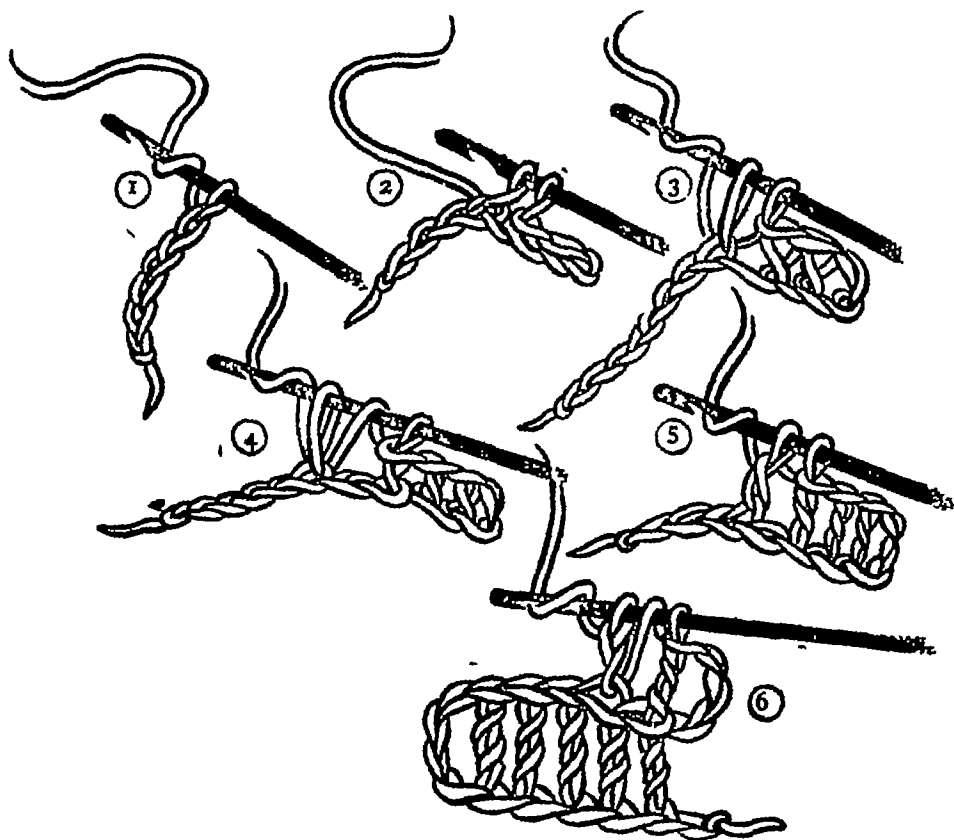
CRIMINOLOGY is the science of crime detection and control A criminologist is one who has studied criminals, their crimes, methods, motives and reformation

See **FINGERPRINTS**

CRITICISM, LITERARY, is the art of judging the value of a piece of writing English critics include DRYDEN, Dr JOHNSON, COLERIDGE and HAZLITT A printed criticism of a book or play is called a *review*

CROCHET WORK is done with a steel hook for fine work in cotton or a bone hook for coarser work in silk or wool. The foundation stitch is chain stitch—make a loop on the hook, then pass the hook from left to right under the thread, draw

similar way. Make a length of chain. Then in the first row miss two chain, pass the hook through the next chain and draw the thread through, pass the thread round the hook and draw this through the two loops on the hook. Repeat to



How the various types of crochet work are done

this thread on to the hook, and draw it through the loop already there. Repeat for the number of stitches required. See 1.

Single crochet—this stitch makes a narrow row. Work the required length of chain, then put the hook through the last foundation stitch you have made, pass the thread round the hook and draw it through both the chain loop and the loop on the hook, and repeat. See 2.

Double crochet—this is a strong solid stitch. There are two varieties, ribbed and flat, both worked in a

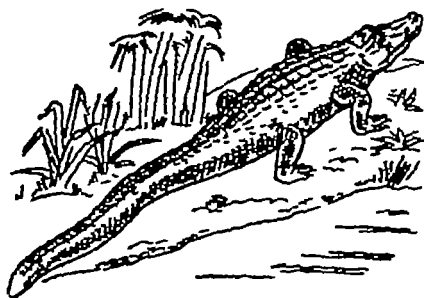
the end of the row. For the second row, make two chain to represent the first stitch. Insert the hook in the second stitch, putting the hook in the back loop of the stitch for ribbed double crochet, and taking up both loops for flat double crochet. Then work as for the first row. Repeat this row to complete the work. See 3.

Short or half-treble—work a length of chain, for the first row miss three chain, pass the thread round the hook, draw the thread through the next chain. There are

now three loops on the hook Draw a loop through all three Repeat to the end of the row For the second row, make three chain (to represent the first stitch), and make a half-treble through each of the following stitches A flat or ribbed surface can be worked as described for double crochet Repeat the second row to complete the work See 4

Treble—work a length of chain For the first row miss three chain, pass the thread round the hook, draw a loop through the next loop There are now three loops on the hook, with the thread over, draw a loop through the first two loops and another loop through the two remaining loops Then repeat For the second row, make three chain to represent the first stitch, and work treble into each of the remaining stitches Repeat to the end of the row, then complete the work For flat or ribbed treble, proceed as for double crochet See 5

Long treble—work a length of chain For the first row, miss four chain Pass the thread twice round the hook, draw a loop through the next chain Draw a loop through the first two loops, another through the next two, and a third through the remaining loops Repeat to the end of the row For the second row, work four chain to represent the first stitch, and then work one long treble in each of the following



Crocodile comes on land

stitches Repeat to the end of the row, and repeat the row to complete the work See 6

Knowing these stitches it is possible to follow crochet patterns The abbreviations in general use are ch = chain, sc = single crochet, dc = double crochet, tr = treble, ltr = long treble

CROCODILE, a large (water-dwelling) reptile with heavy scaly armour The eyes and nostrils are raised, enabling the animal to see and breathe while hardly showing above water Crocodiles catch animals, even human beings, for food, seizing them in their jaws or disabling them with a sweep of the powerful tail Their voice is a roar

Alligators are, in general, like crocodiles, but show differences in teeth Both live in tropical and semi-tropical regions

CROMWELL, Oliver (1599-1658), was born in Huntingdon He entered the third Parliament of CHARLES I (1628) When Parliament was dissolved, he retired to an estate in the Isle of Ely inherited from an uncle

At the outbreak of the Civil War Cromwell trained his famous regiment of Ironsides who defeated the royal troops at Naseby in 1645 From 1647, when Charles was arrested at Holmby House, Cromwell was the real ruler of England After the execution of Charles I and the defeat of Prince Charles, Cromwell dissolved the Long Parliament, elected in 1640 In 1653 a mixed council of soldiers and civilians declared England to be a Commonwealth, and installed Cromwell as Lord Protector He proved a wise if stern ruler, he secured peace at home, and made England respected abroad He was one of the greatest of the PURITANS During his protectorate the island of Jamaica was added to the British



Oliver Cromwell, Lord Protector of the Commonwealth of England

Empire When Cromwell died he was succeeded by his son, Richard, a less able man, who soon resigned. Then Charles II was restored to the throne.

CROMWELL, Thomas See HENRY VIII

CROQUET, a game played with balls which are struck with a mallet and sent through hoops stuck in the ground, the player or team winning who first gets all the balls through the hoops in the correct order as shown in the diagram. The area covered by the four corner hoops is 21 yards long by 14 yards wide, with a boundary 7 yards away from the outside hoops if space allows. A player is entitled to an extra stroke each time he succeeds in sending his ball through the hoop next in order or hits the peg in due sequence.

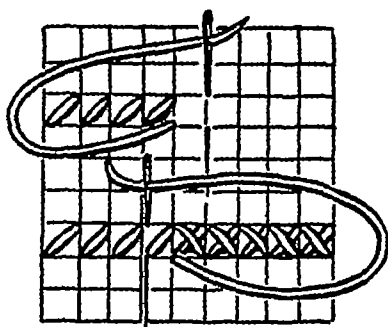
If, after he has gone through the first hoop, he hits an opponent's ball (a *roquet*), he then puts his ball next to his opponent's ball and hits his own ball so as to move

both balls (making *croquet*) or he can put his foot on his own ball so that when struck the opponent's ball moves but not his own. Then he has a second stroke. The object of making croquet is to put his opponent's ball in a bad position and his own in a good one for getting through the next hoop. Having done this, however, he may not repeat this manoeuvre until he has been through his next hoop or to his peg in order.

A ball running over the boundary is replaced at the point where it ran off. When a ball has completed the course and hit the winning peg, it is out of play. The side getting all its balls out of play first wins.

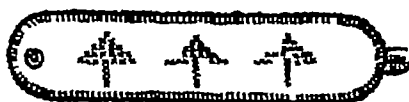
CROSS, the Christian symbol. The Romans brought CRUCIFIXION into Palestine when Jesus called upon his followers to take up a cross, he meant "be faithful unto death." Jesus himself was crucified. Different kinds of crosses are used as symbols by various sections of the Christian Church.

CROSS STITCH is a simple embroidery stitch where two slanting stroke stitches are laid over each other to form a multiplication cross. It is important to cross all stitches over the same way, and to be sure of doing this, first work from left to right marking a row of slanting stitches, each over an equal number of threads as you see at the top of the illustration, then work back along the same row crossing each stitch as you see in the lower part of the illustration.



How cross stitch is done

CROW, a large black BIRD which is resident all over the British Isles. The rook is sometimes mistaken for the crow but has a whitish patch at the base of its bill, its "caw" is less harsh than the crow's,

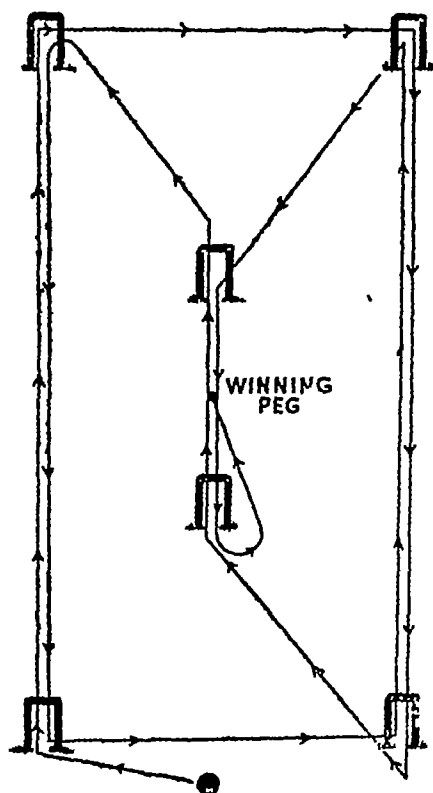


Simple cross stitch design

its beak thinner and its flight faster. Crows live in pairs, feeding on carrion, eggs and young animals, while rooks nest in colonies, feeding together on grain and harmful insects. Pictures on page 76.

CRUCIFIXION was the method by which JESUS CHRIST was put to death. After judgment had been given by PONTIUS PILATE, Christ was taken, together with two thieves, to Golgotha, and was nailed to the CROSS. This was the Roman way of execution. Mary, Christ's mother, and Mary Magdalene witnessed His crucifixion. John, the disciple whom Jesus specially loved, also stood at the foot of the Cross, and Christ committed Mary the mother to his care.

CRUELTY, PREVENTION OF. This normally has reference to animals and children. There are various Acts dealing with this, and the Royal Society for Prevention of Cruelty to Animals (R S P C A) has officials (inspectors) whose duty it is to see that the law is observed. It was in U S A that societies were first formed to deal with cruelty



Order of hoops in croquet



Crusaders' army stretching far across the Holy Land

to children and the example was followed in other countries. In Britain there is the National Society for Prevention of Cruelty to Children.

CRUSADES, or Wars of the Cross, were undertaken by European princes and nobles to free Jerusalem from the Moslems, followers of MOHAMMED. The Moslems had conquered Palestine during the 7th century, but it was not until the Turks arrived there that Christian pilgrims were molested when visiting the Holy Places. In 1095 Pope Urban II called a great council at Clermont, in France, at which he appealed to the princes and nobles to forget their petty quarrels, and unite to drive the Turks from the Holy Land.

Some were so eager to set out that they made their own way, in

three undisciplined bands, without provisions or equipment, across Europe to Constantinople. Thence they were promptly shipped to Asia where most of them perished. The first real Crusade set out a year later (1097), reached Asia Minor, and took Antioch. Jerusalem was stormed and taken in 1099, and Godfrey de Bouillon, a French knight, was elected King of Jerusalem.

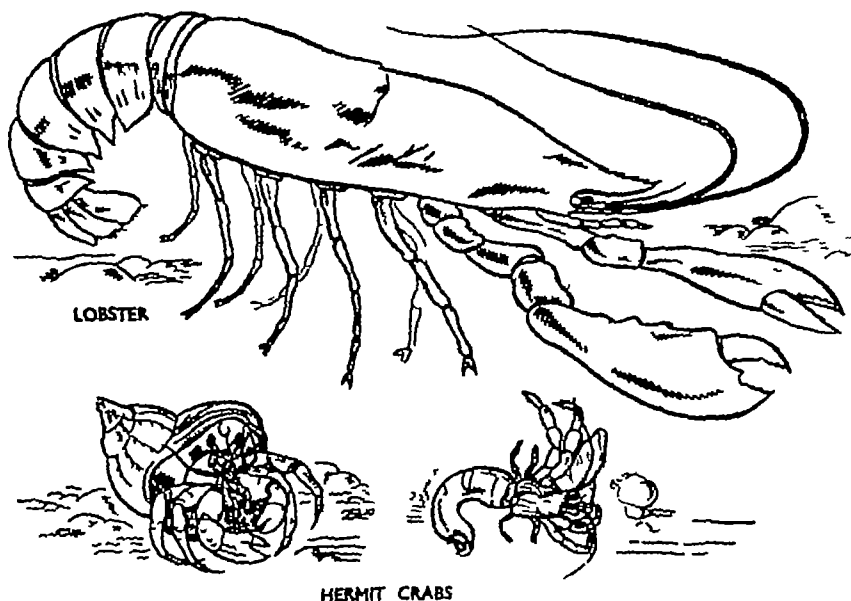
Before long the Moslems began fresh attacks, and a Second Crusade was organized (1147), but without success. In 1171, Saladin, the greatest of all the Moslem leaders, became Sultan of Egypt. He united all the other Moslem states under his leadership, invaded the kingdom of Jerusalem, and took the Holy City (1187). When the news of this disaster reached Europe, a Third Crusade was organized.

RICHARD I, the Lion Heart, who had succeeded his father, Henry II, as King of England, joined the Crusade and did many mighty deeds. He helped to capture the city of Acre but was at last forced to make peace with Saladin, who promised, however, that Christians should be free to visit the Holy Sepulchre.

Other Crusades took place, in 1202-1204, 1218-1221, 1228-1229, 1249 and 1270, but they failed to free the Holy Land. The Crusades had other important results, however, for there was a great increase in trade with the East. This trade brought wealth to the Italian cities of Venice and Genoa, from which fleets of trading vessels set out to fetch goods from the eastern Mediterranean area, and distribute them to other European countries. Contact with the East taught Europeans many useful things, including, probably, the use of the mariner's compass, and paper. Many new plants were brought to Europe, among

them the orange tree and the rose tree. And a general interest in distant lands inspired explorers of later days.

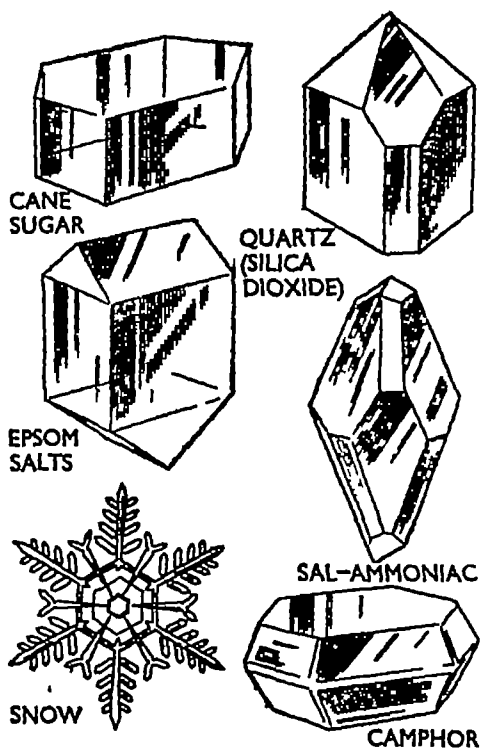
CRUSTACEANS are a group of animals belonging to the **ARTHROPODS**, with jointed legs and, generally, a limey outside skeleton. Crabs, lobsters, crayfish, prawns, shrimps, sand-hoppers, **BARNACLES**, wood-lice and water-fleas are included. The young hatch from eggs, often into a form very unlike that of the parent, and moult their shells from time to time as they grow. They have numerous paired legs, the front ones being used for feeding, the pincers as weapons, and others for walking, swimming or leaping. In crabs the hind end of the body is generally folded underneath. In hermit crabs, which live in empty whelk or other shells, it is soft. Tropical land crabs return to water to breed. Prawns differ from shrimps in having a jagged beak growing forwards between the eyes, and are usually larger and



Crustaceans use their pincers as weapons, and their front legs for feeding

marked by vertical dark bands of colour

CRYSTAL, a solid in a definite geometrical shape which has been



Magnified crystal shapes

formed either from a SOLUTION of a substance or by its cooling from a liquid state

CUBA is the largest island of the WEST INDIES. It is famous for its cigar tobacco, grown near Havana, the capital, sugar is also grown. Havana is a well-known tourist resort, and is linked by a railway with other coast towns and with a U.S.A. naval base at the other end of the island. The official language is Spanish. See map of CENTRAL AMERICA.

CUCKOO, a summer migrant BIRD (see MIGRATION) wintering in Africa, with slate-grey back and barred breast, pointed wings and a long tail. The female makes a bubbling note, the male sings "cuckoo."

They eat caterpillars, beetles and worms. The eggs are laid singly in the nests of other birds, such as hedge sparrows and meadow pipits. These rear the young cuckoo after it has thrown out the other eggs or nestlings. See picture on page 76.

CUNEIFORM WRITING is wedge-shaped characters in rock, stone, brick or clay, done by scribes of the ANCIENT WORLD.

CUPID, in CLASSICAL MYTHOLOGY, is the boy god of love, son of VENUS. He carried a bow and a golden quiver of arrows which, as he was often blindfolded, he shot indiscriminately. The Greeks called him Eros.

CURIE, Marie and Pierre, were physicists, Pierre (born 1859), being a Frenchman, his wife a native of Poland. Marie Curie (born 1867) received her early scientific training from her father. She studied at Cracow and then at the Sorbonne, the University of Paris, where in order to meet the necessary expenses for fees, books and living, she undertook work connected with the care of the laboratories. She met Pierre Curie whom she married. He was a professor of physics.

In 1890 they began to examine pitchblende to see what other radio-active substances it had besides URANIUM. They found a new substance, which they called polonium, in honour of Poland. Further research led to the discovery of RADIUM, an entirely new ELEMENT. In 1906 Pierre was killed in a road accident but Marie continued their research at the University. She died in 1934.

Radium has been used extensively in the treatment of cancer and skin diseases.

CURRENCY. In Britain the unit of currency is the pound (£), consisting of twenty shillings, the shilling being worth twelve pence.



Marie Curie discovered radium

In America the unit is the dollar (\$), which is worth one hundred cents, five cents making a nickel and ten cents making a dime. In France they have the franc, which is worth one hundred centimes, in Italy, the lira, worth one hundred centesimi, in India, the rupee, worth sixteen annas, in Russia, the rouble, worth one hundred kopeks, in Germany, the mark, worth one hundred pfennigs—the pfennig coin is obsolete, but there are still, however, fifty-pfennig pieces in circulation.

CURRENT, ELECTRIC. Electricity is known by its effects—magnetic, heating, chemical, and nervous. A current flowing in a coil of wire will affect a nearby magnet, if strong enough, it may make the wire through which it is passing red-hot or even melt it, if passed through certain salt solutions, it will split the salt into its constituents, and it will affect the nerves of living creatures and give them a shock.

The current is caused by the flow in a conductor of **ELECTRONS**, par-

ticles of negative electricity coming from atoms of a substance which is being partly broken up and left positively charged. When these electrons flow continuously in one direction only, the current is direct current (shortened to D C.)

Often, however, it is easier to generate electricity and transmit it over a considerable distance if the current is alternating, i e the electrons **OSCILLATE** backwards and forwards at about fifty times a second. Hence the mains supply to most houses is alternating current (shortened to A C.) See **ELECTROMAGNET**, **ELECTROSTATICS** and **GENERATOR**.

CUTTLEFISH See **MOLLUSC CYANIDES**, salts of **PRUSSIC ACID**, are intensely poisonous compounds used in the killing of vermin, in the winning of gold from its ores and in electroplating.

CYCLING is a serious sport, either racing with special lightweight machines on a track, or long-distance racing on the less-frequented roads of the countryside. But it is also a popular means of getting into the country, strong bicycles, specially built for touring, are used for this purpose. Although the cyclist has to keep to the roads, and cannot get into the wild open spaces, yet it is possible for him to cover many more miles than the hiker (See **HIKING**). When touring, don't carry anything on your back. Keep your necessities in a saddle bag, on the carrier, or perhaps in pannier bags at the sides of the wheels. Besides tools and a repair outfit, you should carry oilskin cape, leggings, and sou'wester, eye-shade, spare clothes, maps, compass, knife, torch, first-aid tin, spare batteries and bulbs for the lamps. Food for the midday meal is best carried with you in tightly-closed tins, a drink in a vacuum

flask or water bottle The evening meal, tea, is usually easy to get

If you are spending your nights under canvas you will have to carry much **CAMPING** equipment But cyclists have more than one organization which provides for its members lists of addresses where bed and breakfast can be obtained at reasonable rates

Keep the bicycle wheels, gears, chain and pedals oiled, remember that oil, grease and heat are injurious to tyres, treat leather straps and the underside of the saddle with dubbin To repair a puncture, clean round the hole, apply the sticking solution to the tyre, and wait until it is nearly dry before pressing on the patch, dust round the patch with french chalk before replacing the inner tube in the tyre Keep your saddle dry

CYCLONE and ANTI-CYCLONE. A cyclone is a violent **WIND** storm with an area of calm in the centre The word also refers to an area of low atmospheric pressure surrounded by anti-clockwise winds in the northern hemisphere and by clockwise winds in the southern hemisphere An anti-cyclone is an area of high atmospheric pressure surrounded by clockwise winds in the northern

hemisphere and by anti-clockwise winds in the southern hemisphere

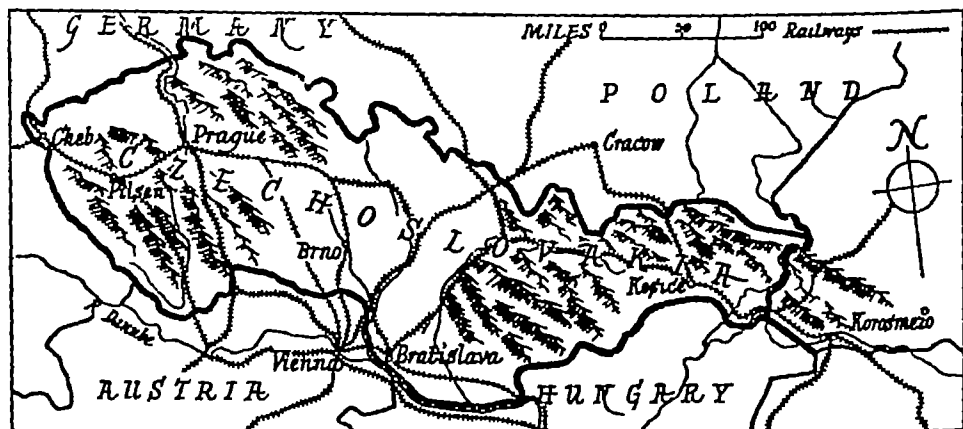
CYCLOPS, in **CLASSICAL MYTHOLOGY**, are a race of one-eyed giants living in Sicily They were shepherds and also workmen employed by **VULCAN** in making armour for gods and heroes The best known was Polyphemus, slain by **ODYSSEUS**

CYLINDER, a steel vessel or structure which can hold liquids or gases at considerable pressures See also **ENGINE**

For the area and volume of a cylinder, see **MENSURATION**

CYPRUS is a mountainous British island colony near the eastern end of the Mediterranean The people, of Turkish and Greek ancestry, grow cereals, fruits, vines and olives and export copper, asbestos and wine The capital is Nicosia See map of the **NEAR EAST**

CZECHOSLOVAKIA is a republic including the west Slav group—Czechs, Moravians and Slovaks Prague, the capital, lies in the fertile plateau of Bohemia Manufactures are based on the rich coal and iron ore deposits Important ones are armaments, others are textiles, glass, chemicals, shoes, sugar and beer Paper is made from imported raw materials



Czechoslovakia, young republic of the western Slavs

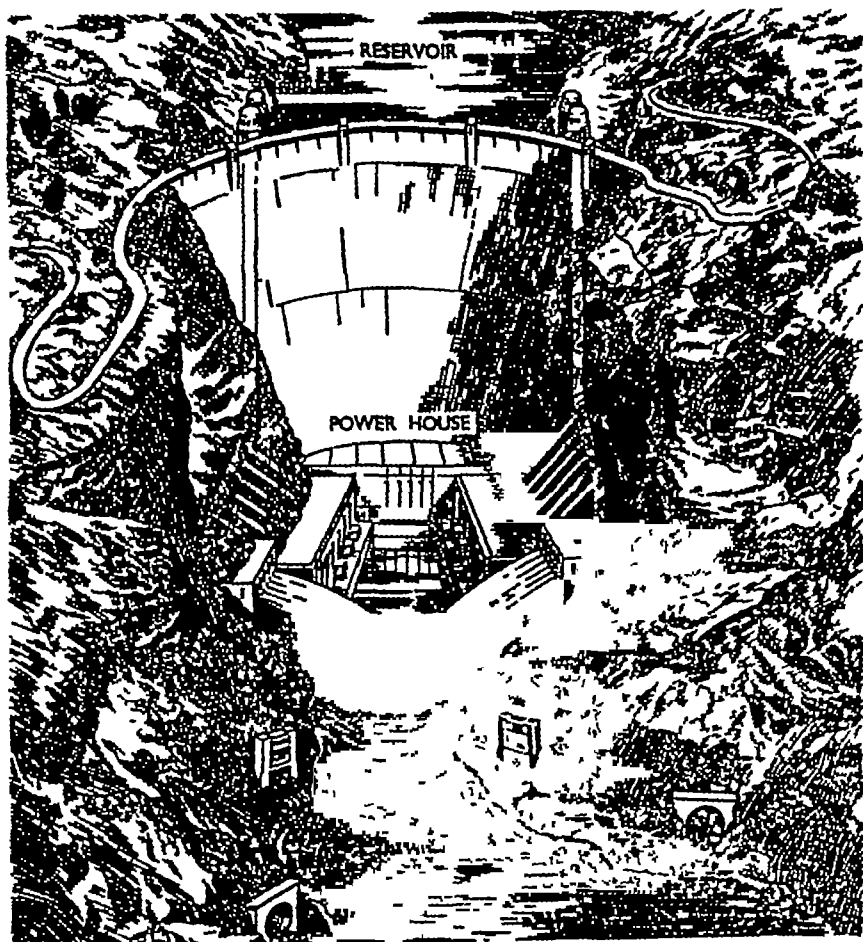
D

DACTYL See PROSODY

DAEDALUS See ICARUS

DAM, an obstruction placed in the way of a stream of water for one or more of four purposes (1) It may keep water away from the foundations of a bridge or building which are being laid below water-level It is then made of interlocking steel plates which hold back the surrounding water, and is called

a coffer dam (2) A dam stretching right across may raise the level of a part of a river and thereby make it more valuable for navigation by ships (3) It may hold back water for irrigation or similar purposes It then usually turns a river valley into a reservoir, so that winter excess can be stored and used during summer drought (4) It may control the flow of a stream evenly for HYDRO-



Boulder Dam, with position of water channels to power house and spillways for the overflow Note the mouths of four tunnels through which the river was diverted while the dam was being constructed

ELECTRIC power generation Most of the large dams, such as that at Aswan on the Nile and Boulder Dam on the Colorado River, perform both the two latter duties

DANCING is the expression of emotion through rhythmic and periodic movements Every nation has its own dances The folk dances of England (the Morris dances and country dances) differ widely from those of Scotland (strathspeys, flings and reels—see p 510) and neither have much in common with the mazurkas of Poland Every period of history has also had its characteristic formal dances The pavans and galliards of the Elizabethans gave way to the minuets and gavottes of the 17th and 18th centuries, and these, in turn, disappeared from ballrooms with the advent of the polka, quadrille and lancers The introduction of the waltz set a new fashion in the ballroom Many modern dances are built on rag-time and JAZZ, a type of music which, with the insistence on syncopation, can be traced back through the American slaves to an origin among the races of Africa See **BALLET**

DANTE ALIGHIERI (1265–1321), was a native of Florence, his poetry is the flower of Italian literature Such was the influence of his *Divine Comedy* (in the medieval sense comedy is action moving towards a happy ending) that the language used in it became the language of all Italians

DANUBE, one of Europe's greatest rivers, second in length to the Volga It rises in the Black Forest of Germany and drains parts of Austria, Hungary, Jugoslavia, Bulgaria and Rumania

DARK AGES, the name given to the period of European history from the fall of the Roman Empire (476) till about the 11th century

Out of the ruins of the Roman Empire new kingdoms began to rise—the Franks in France, the Visigoths in Spain, the Lombards in Italy, the Vandals in North Africa and the Anglo-Saxons in Britain.

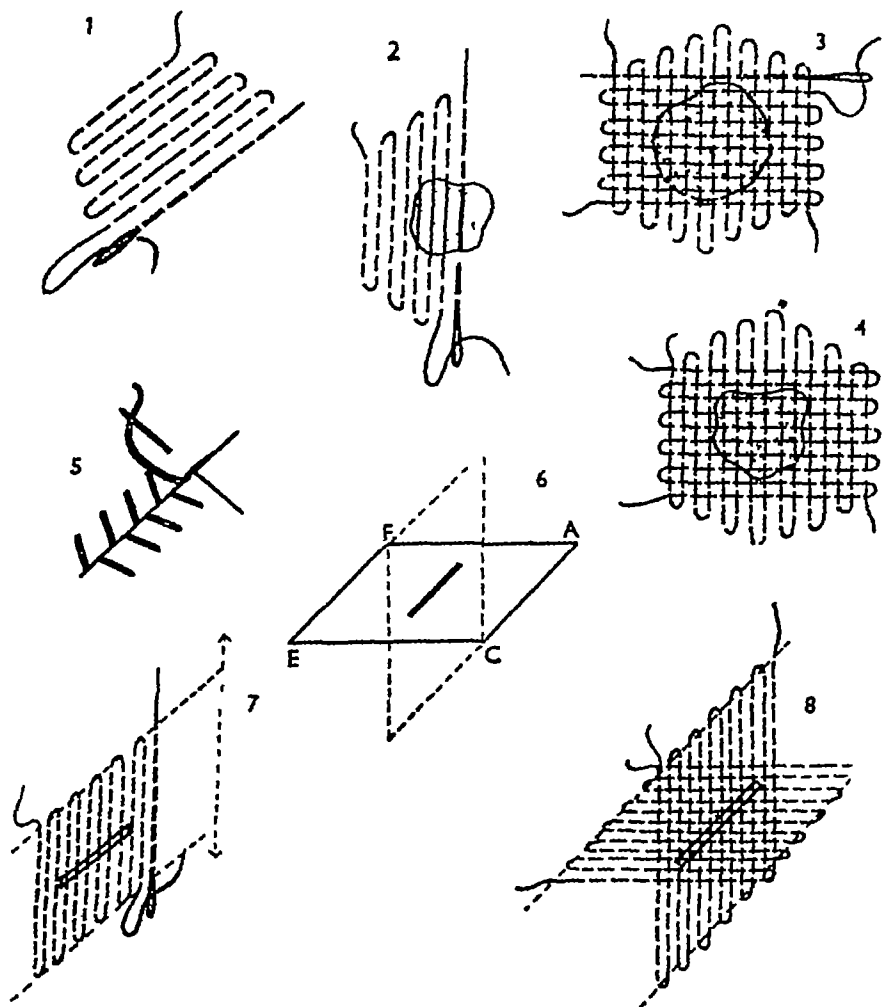
In the 8th century another danger appeared The pagan Northmen—Vikings, Danes or Norsemen—began their raids Churches were everywhere looted and monasteries destroyed, while numbers of valuable hand-written books perished in the flames—in those days few but priests could read or write See also **CHARLEMAGNE** and **MIDDLE AGES**

DARNING is the best method of mending weak or thin places in materials and of filling in small holes In colour, thickness, and texture, the darning threads should match the material to be darned A darning block is placed under the hole or thin part, the stitches should extend far enough round the darn to be on strong material Make the darn lozenge-shaped or diamond-shaped, to avoid pulling Darning is worked on the wrong side The stitch is a **RUNNING STITCH** (see 1) with the spaces roughly equal to the stitches Begin at the corner of the part to be darned and work up and down in the same direction as the threads of the material Then work to and fro across your first threads, weaving under and over each thread alternately Loops are left at the end of each row to allow for shrinkage in washing In darning, the aim is to replace those threads of the material which have worn away or are thin therefore the stitches of the darn must follow the threads of the material If darning is worked too tightly the garment may be pulled out of shape, if it is too heavy, the material will be strained and will tend to tear again

To darn a hole in knitted material, begin outside the thin part, and make the first row of darning at least as wide as the hole, increasing the width gradually over the middle of the hole (see 2). When crossing the hole, each darning thread should pick up a loop of

texture of the garment. The finished darn is shown in (4).

Cross-cut darning is used to mend slits in tablecloths or towels. Using a fine sewing cotton, draw the edges of the cut together with a FISHBONE STITCH (see 5). Make two creases AC and FE parallel to the cut and



Various types of darn for repairing holes and thin places

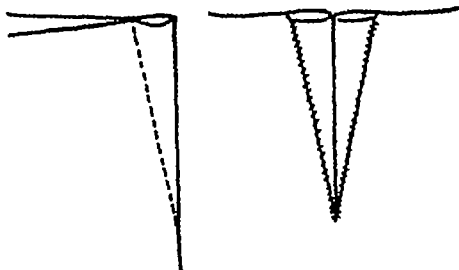
the web on each side. To work the cross darnings, begin beyond the hole and darn over and under the darning thread (see 3). Work the threads over the hole so closely that the darn is similar to the

about $\frac{1}{8}$ inch away from it on either side (see 6) or more if the cut is very frayed. Darn up and down in the direction of the selvedge or warp threads (see 7), leaving short loops. Turn the work and darn in

the direction of the weft threads (see 8) Note that the part covered by the double darning completely covers the cut

Thin places can be mended by single darning on the wrong side of the article the first illustration shows a typical thin-place darn

DART, in dressmaking, a tuck used to give a closer fit, and to take out superfluous material Mark



How a dart is made in dressmaking

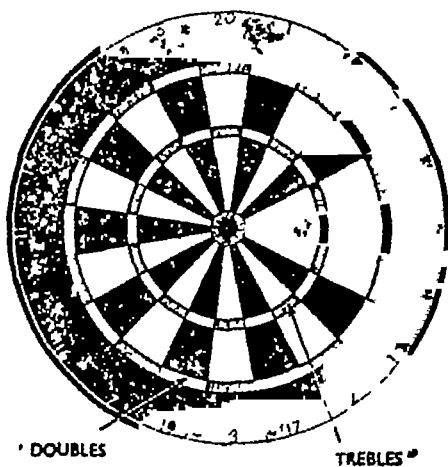
the position of the dart, pin and stitch it to a tapering point, then cut along the fold, open flat and make the raw edges neat with over-sewing

DARTS is a game played with pointed darts thrown at a board marked with numbers as in the diagram, darts sticking in any part of the ring marked "doubles" score double the figure of that section, while those darts in the ring marked "trebles" score three times that figure In addition, the bull's eye counts 50 and the slightly larger circle 25 The board is fixed five or six feet from the ground and the throwers stand behind a line drawn nine feet away In the single-handed game, each player starts with a score of 301 (501 for a pair, 1,001 for a team) from which a player's score is deducted Each player throws three darts at each turn, but he must get a double before he starts scoring The player (or team) wins who first reduces the score to 0, but a player must

reduce it to 0 with a double and that double must be the exact number required If, for example, he wants to score 17, he must get an odd number less than 17, then with the next dart get a double that brings the total to 17 if the player got 16 or more with his darts, then the combined score for all the darts thrown during his last turn would not count.

DARWIN, Charles (1809-1882), was a great scientist whose name will always be linked with his theory of **EVOLUTION**. After five years' voyaging round the world in H M S. *Beagle*, Darwin spent his long life studying, experimenting and writing books, interpreting the lives of animals and plants in the light of evolution which changed the scientific thought of the time

DAVID, son of Jesse, was a shepherd, and lived about 1000 B C When the armies of King Saul were in battle against the Philistines, David defeated Goliath and gained the favour of the king He became the friend of the king's son, Jonathan Saul grew jealous of David's popularity and wisdom, and made several attempts to kill him, so David fled David later became King of Judah, and finally, King



Dart board



Darwin, writer on evolution

of Israel. He also brought the Sacred Ark to Zion, and wrote some of the Psalms.

DAVID, St., the patron saint of Wales, was born at Menevia (St. David's), and is known as the founder of monasteries at Glastonbury, Leominster, Bath, Raglan, Repton and Crowland. He became Archbishop of Caerleon, near the modern town of Newport, Monmouthshire.

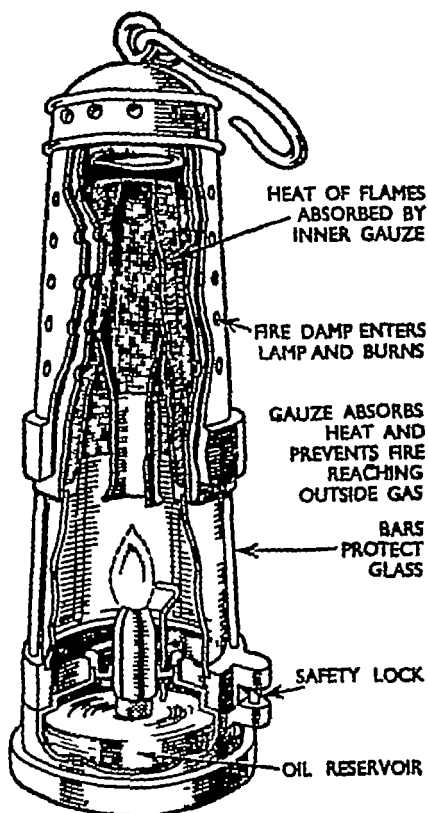
David removed his archbishopric from Caerleon to Menevia, which came to be called St. David's. He died about A.D. 601, and was canonized in 1120, his saint's day being fixed as 1st March.

DAVY LAMP Before the days of electric light, the open flame lamps used by miners caused the explosion of inflammable gases, such as FIRE-DAMP, present in the mine. Sir Humphry Davy in 1816 encased the miners' lamp in metal gauze, through which the lamp flame could only pass with extreme difficulty, its heat being absorbed by the gauze, any gas which entered the lamp burnt inside without

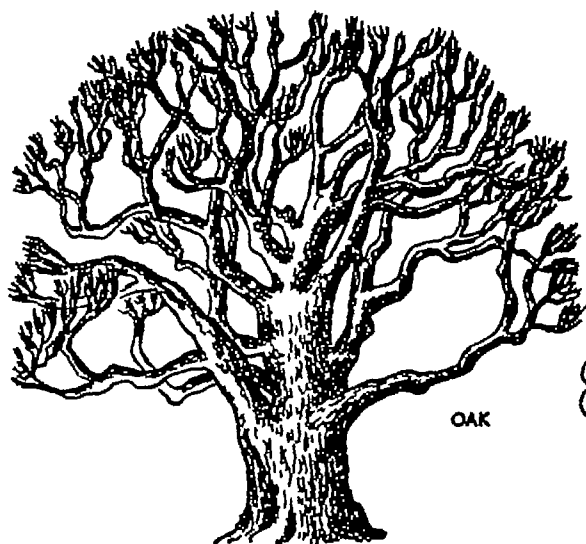
setting fire to the gas outside. In the modern lamp, the flame is surrounded by glass, with gauze only in the upper part of the lamp.

DEACON, a Church officer. A man is first ordained as a deacon, usually for one year, before he is ordained a priest. In the Greek Orthodox Church deacons often remain as such for life. See **CLERGY DEBIT**. See **BOOK-KEEPING**.

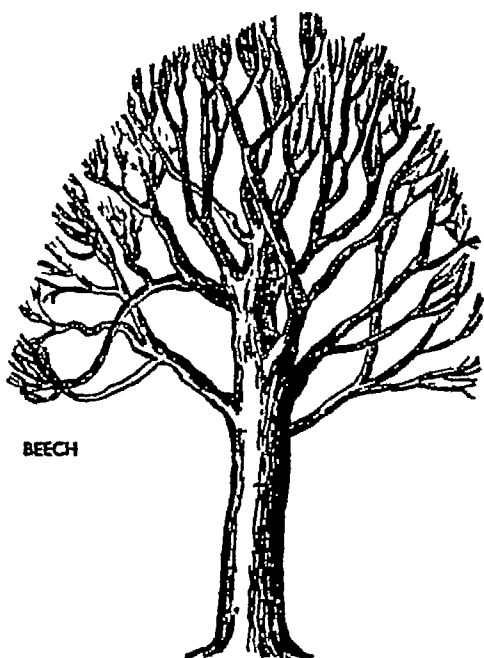
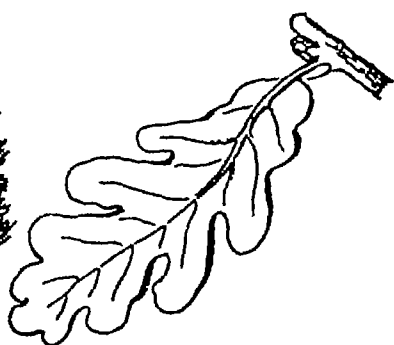
DECARBONIZING is the process of removing the layer of carbon which forms in the cylinders of an internal combustion **ENGINE** and on the top of the piston owing to the partial burning of the lubricating oil. This carbon deposit not only chokes the valve passages but also causes knocking and loss of power until chipped away.



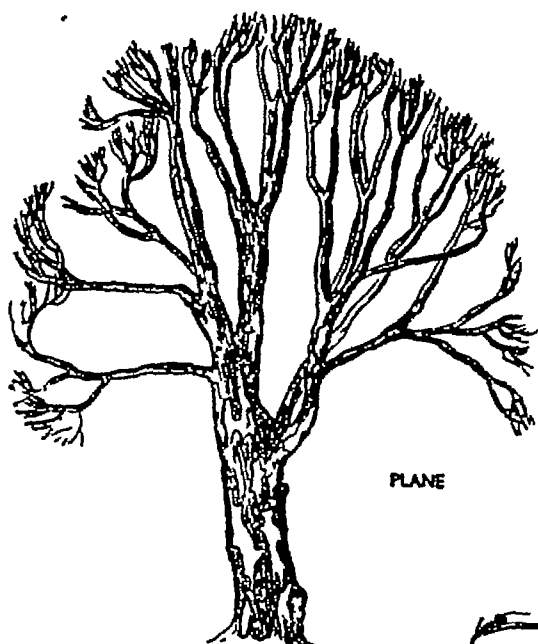
Davy safety lamp for miners



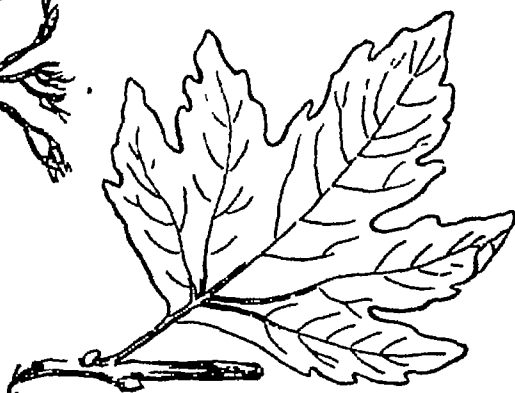
OAK



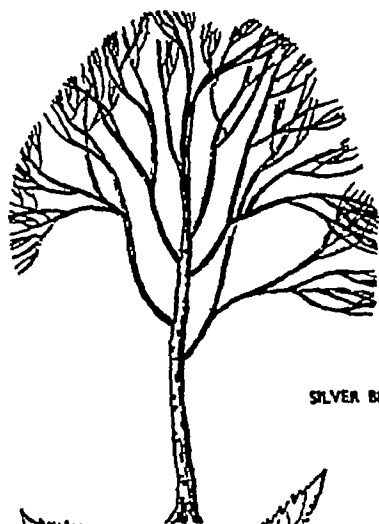
BEECH



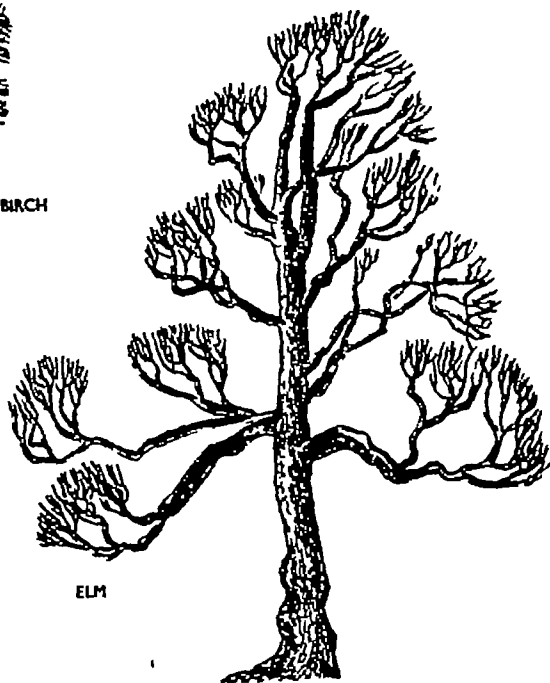
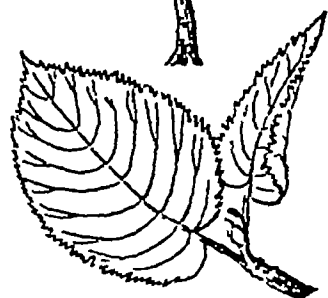
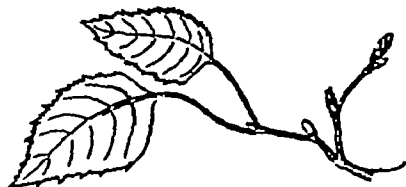
PLANE



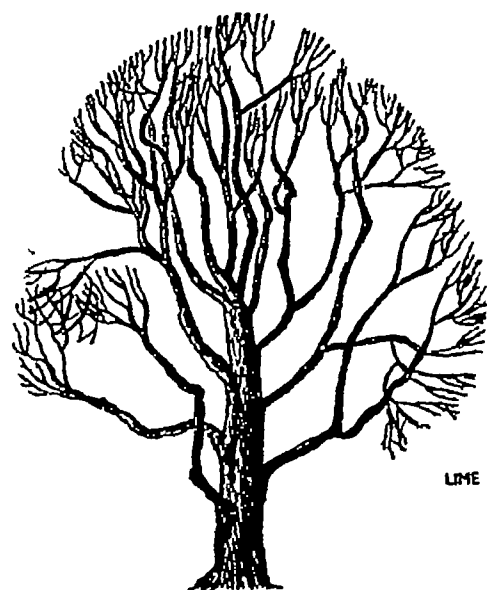
In winter-time, deciduous trees have recognizable outlines;



SILVER BIRCH



ELM



LIME



in summer-time, they can be identified by their leaves See p 168

DECIDUOUS TREES are those which shed their leaves each autumn, remaining leafless till the spring. Leaves give out a large amount of water vapour, and deciduous trees cannot afford to lose so much in winter, because the activities of the root hairs are curtailed or stopped by the low soil temperatures. See **LEAF**.

Pictures of deciduous trees appear on pp 166-167

DECIMALS. (1) Our ordinary numbers are decimal, that is, they go up in powers of 10 1, 10, 100, 1,000, 10,000, and so on. We can equally well go down in powers of 10 $\frac{1}{10}$, $\frac{1}{100}$, $\frac{1}{1000}$, and so on. To write numbers as decimals we put a dot before the fractional part to separate it from the whole number part. 34.687 stands for $34 + \frac{6}{10} + \frac{8}{100} + \frac{7}{1000}$. If there is a gap we put 0 to show the gap. 0067 = $\frac{6}{1000} + \frac{7}{10000}$. The 00 merely show there are no tenths and hundredths.

(2) In adding, we put the decimal points one under another. this ensures that units come under units, tenths under tenths, and so on. We then add up just as if we were adding whole numbers.

$$\begin{array}{r} 3.67 \\ 18.745 \\ 0.96 \\ 4.8 \\ \hline 27.311 \end{array}$$

(3) Subtraction is done like subtraction of whole numbers. If there is a gap at the end of the upper number we can fill it with 0 or 0's if we like. (Adding 0 thousandths to a number makes no difference to it.) $20 - 3.684$ may be written as $20.000 - 3.684$. The 000 makes no difference to the 20, but it makes subtraction easier. Notice in the example that decimal points come under each other.

$$\begin{array}{r} 14.830 \\ 6.785 \\ \hline 8.045 \end{array}$$

(4) When multiplying, we have to think of the value of each number in the multiplier. To multiply

by 7 ($= \frac{7}{10}$) we go out one place beyond the 8, and multiply by 7. To multiply by 006 ($= \frac{6}{1000}$) we go out 3 places, beyond the 8, and multiply by 6. (As a check we count the number of decimal places in the numbers multiplied, in this example $2 + 3 = 5$; this should be the same as the number of decimal places in the answer.)

$$\begin{array}{r} 4.08 \\ \cdot 706 \\ \hline 2.856 \\ 0.0000 \\ \hline 0.2448 \\ 2.88048 \end{array}$$

When multiplying several small numbers we can multiply them as whole numbers, and then count the number of decimal places (e.g. $1 \times .2 \times 3 \times 4 = 24$. There are 4 figures behind decimal points, so there will be 4 decimal places in the product, i.e. 0.024). $01^3 = .01 \times .01 \times .01 = 0.001$. There are 6 figures behind decimal points, so the cube of 01 is 0.000001).

(5) Simple division sums can be written as fractions. We can then multiply numerator and denominator by the same power of 10, to make the divisor a whole number.

$$14.725 \div .0034 = \frac{14725}{34}$$

Multiply by 10,000 or move all the figures 4 places to the left of the decimal point = $\frac{1472500}{34}$. We then have ordinary division by 34.

(6) To turn a fraction into a decimal, divide the numerator by the denominator. To turn $\frac{1}{7}$ into a decimal, put the decimal point after 1, and then we can fill in as many 0's as we need. $\frac{1.000000}{7} = .142859$. In the answer 1 is $\frac{1}{10}$, 4 is $\frac{4}{100}$, 2 is $\frac{2}{1000}$, 8 is $\frac{8}{10000}$. If we want to approximate we can write the answer as $\frac{1}{7} = 143$ or 1429.

(7) To change decimals to common fractions we write them over the proper power of 10.

$$8 = \frac{8}{10} = \frac{4}{5}, \quad 75 = \frac{75}{100} = \frac{3}{4}, \quad 05 = \frac{5}{100} = \frac{1}{20}, \quad 875 = \frac{875}{1000} = \frac{7}{8}.$$

Decimalizing money. To decimalize £17 13s 9½d write 9½d as 9 75d Divide by 12 (8125s), write 13 before this for the shillings (13 8125) Divide this by 20 (divide by 2 and move the figures one place to the right, £ 690625) Write 17

also to certain examples of art, appealing to the eye rather than to the mind See also DESIGN

DEER. In Britain live three kinds of deer The largest, the red deer, are common in Scotland and also roam the New Forest and Exmoor



Defoe's Robinson Crusoe finds a footprint in the sands

before this for the pounds The answer is £17 690625

To change back, multiply the decimal by 20, to turn it into shillings £17 690625
= 13 8125s

Multiply the decimal part of the shillings by 12 to turn it into pence = 9 75d

£17 690625 = £17 13s 9½d

DECORATION is any ornamental treatment of buildings, interiors, pottery, furniture, dress, etc, often characterized by the repetition of a pattern It is applied

where they are hunted The dappled fallow deer, with flattened antlers, live in many parks, while the smallest, the roe deer, are rare and seldom seen See also HOOVED MAMMALS

DEFOE, Daniel (1660-1731), was born of Nonconformist parents, who intended him for the ministry Little is known of his life before his marriage in 1684, except that he was a wholesale dealer in hosiery and travelled in France, Spain, Italy and Germany He took part in Monmouth's rising against James II, and in 1688 joined the army of

William of Orange, William III.

In 1702 a pamphlet, "The Shortest Way with the Dissenters," led to his imprisonment and pillorying, and also to his financial ruin. For the rest of his life he earned his living mainly by journalism. In 1704 he started his newspaper, *The Review*, which appeared thrice weekly, and was written practically single-handed by Defoe. These were the early days of the periodical, and the few NEWSPAPERS then were little bigger than broadsheets, although expensive to buy. He also wrote a large number of political pamphlets—his published writings number about 250 works—and travelled extensively in Scotland as a secret political agent, his services being at the disposal of both **TORIES** AND **WHIGS**.

Robinson Crusoe, his best-known work, was written in 1719, followed by a second part of the book a few months after the success of the first. It purported to be the actual adventures of a shipwrecked mariner, and is in fact founded on the career of Alexander Selkirk who suffered the fate of Robinson Crusoe. What is new, however, is that here we have not a real biography such as were frequently written and read at this time but a *faked* one—fiction. From this time on writers and their public discovered that an invented or imagined biography could be just as interesting as a real one. It is the beginning of the novel and Defoe is its father. All Defoe's novels, such as *Journal of the Plague Year* and *Moll Flanders* (both 1722), are written with an abundance of detail to convince the reader that they are true stories. They are written, too, in the autobiographical form so that the author need never step into the minds of other characters or challenge the reader's doubts by seeming to know too much. In

time, however, writers discovered that readers would gladly banish their doubts while they enjoyed the story, so that later writers like Dickens and Thackeray have no difficulty in describing in different parts of the same book what was going on in two places at once—just as though they could have been in both at the same time. See **FICTION**.

DE LA MARE, Walter John (b. 1873), is a poet and novelist, some of whose best work has been



Walter de la Mare, poet

written for children, such as *The Three Mulla Mulgars* and a collection of verse, *Peacock Pie*. His novels include *Henry Brocken* and *The Memoirs of a Midget*. Collections of his poetry are *The Listeners*, *The Veil* and *The Fleeting*, favourites among his lyrics being *Nod*, *Silver* and *Arabia*.

DELPHI is a town near Mount Parnassus in Greece, where stood the temple of **APOLLO** with the oracle in the centre. When questions were asked, it was believed

that Apollo himself inspired the answers which were uttered by the priestess. The answers were framed in such a way that they always came true. See CLASSICAL MYTHOLOGY.

DELTA. See RIVER.

DEMOCRACY is the form of government best defined in Abraham Lincoln's words "government of the people, by the people, for the people." Democracy, originally a Greek word, means "rule by the people," and was used by the ancient Greeks to denote a small state ruled according to the will of the people gathered together in one assembly. It was very different from the other forms of government: oligarchy, which was "rule by a few men", aristocracy, "rule by one or more of the noble families", tyranny, "rule by one man" (for its modern form see TOTALITARIAN STATE).

Today, when populations are vast, a democracy could not of course assemble the whole people together to make the laws. The people must therefore vote for representatives who will assemble and govern on the people's behalf.

The principal feature of democracy is that government must rest on the will of the people as expressed through their representatives—members of Parliament, etc.—elected for that purpose. What is more, their representatives must recognize that they are responsible to the people as a whole. See PARLIAMENT and HOUSE OF COMMONS.

DEMOSTHENES (about 385-322 B.C.), was the greatest Greek orator. His speeches were designed to rouse the GREEKS to the danger threatening them from Macedonia and its king, Philip.

DENMARK lies on a PENINSULA dividing the North Sea from the

Baltic. It has no coal, iron or water-power, and its manufactures depend on imports. The soil is poor, but farming is highly organized on a co-operative system, and Denmark is famous for dairy products and bacon. The capital is Copenhagen. See map of SCANDINAVIA.

DENSITY of a substance is its weight or mass divided by its volume. Thus water has a density of 62.4 pounds per cubic foot, paraffin oil a density of 8.4 pounds per gallon.

See ARCHIMEDES.

DEPRESSION, an area of low atmospheric pressure where warm and cold air currents meet, causing belts of cloud and rain to be formed there.

DESERT, an area with little or no vegetation. *Cold* deserts are found in the ARCTIC AND ANTARCTIC regions and above the snowline in mountain areas, where the only vegetation is patches of moss, lichen, dwarf bushes and alpine flowers. *Hot* deserts are found in tropical latitudes on the west side of continents, where temperatures are always high and rainfall very low. Vegetation is adapted to store water and is protected by spines, e.g. the CACTUS. OASES are scattered points where water is obtained from springs and wells, some are stopping places on caravan routes, and a few have large towns surrounded by date palms and millet fields.

See also AFRICA.

DESIGN is the pattern or plan of a work of art. Today it has an even wider meaning, referring, for example, to the shape, colour and style viewed as a whole of almost anything made by hand or manufactured. Thus we speak of the design of a hat or a motor car. In art, however, we think of design as the composition or arrangement of



Recurring pattern as design

the shapes, lines, colours, and tones, that make up either a picture or a recurring pattern such as could be used for a wallpaper, carpet or fabric

DEVIL. Many Christians and others try to explain the presence of evil and ill-doing in the world by attributing them to the Devil (also called Satan) who is viewed as the inspirer of wickedness in mankind and the great leader of the spirits of evil

DEWPOND, a shallow bowl-shaped depression on a hill, constructed so as to enable dew and rain to form on its sloping sides and collect in a pool for cattle

DIALECT is a form of language peculiar to a district and having a large number of words different from those in standard use Poems such as Burns's "Tam o' Shanter" and Tennyson's "Northern Farmer" are in dialect

DIAMETER. See **CIRCLE**

DIAMOND, an extremely hard transparent stone, a form of carbon, when cut, very brilliant in reflected light, and so valued for personal adornment It is used in industry for cutting, grinding and polishing

DIANA (Greek Artemis) is twin sister of **APOLLO** She is goddess of the moon and of hunting, according to **CLASSICAL MYTHOLOGY**

DIAPHRAGM is (1) An arched sheet of muscle separating the thorax from the abdominal cavity in mammals See **RESPIRATION** (2) A thin flat surface such as parchment or beaten metal taut like the skin of a drum and giving forth sounds when made to vibrate See **GRAMOPHONE** and **TELEPHONE**

DIARY, a systematic record of the interesting events and thoughts in a person's daily life, written to please the writer, rather than with any thought of publication

DICKENS, Charles (1812-1870), came of a poor family His father was imprisoned for debt in the Marshalsea prison, while Charles was obliged at a very early age to earn his living in a blacking factory This experience is used in *David Copperfield*, the character of Mr Micawber is said to have originated from that of Dickens's father



Dickens, novelist-reformer

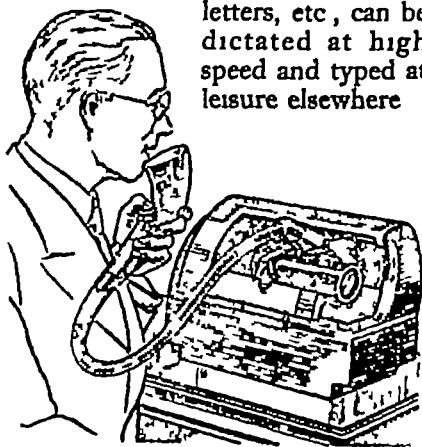
Dickens became a reporter of parliamentary debates in 1835. From 1833 he had contributed to magazines, the sketches being published as *Sketches by Boz* (Boz being his pen name). *The Pickwick Papers* began to appear in serial form in 1836. *Pickwick* was an immense success, and from this time he wrote almost without ceasing, much of his work appearing in serial form. Lecturing in America, he received a mixed welcome. Some of his experiences there are used in his book *Martin Chuzzlewit*. He died at Gadshill, a large house he had bought near Rochester, which he had coveted as a boy. He is buried in Westminster Abbey.

His stories did much to arouse the imagination of comfortable people to the miseries of the very poor, which form the theme of *Oliver Twist* and appear in *Bleak House* and elsewhere. Other social evils such as the delays of the law, the dreadful state of prisons, the exploitation of children, and schools which were money-making swindles were vigorously exposed. His novels are crammed full of lively and humorously painted characters like Micawber, Sam Weller and Mark Tapley—the richest portrait gallery since Shakespeare's plays. Apart from those mentioned you should read *Nicholas Nickleby*, *A Christmas Carol*, *Dombey and Son*, *Great Expectations*. See pp 174-175 for scenes from Dickens's novels.

DICTAPHONE, an electrical machine on the GRAMOPHONE principle for recording human speech. A waxed cylinder is scratched by a needle point on a diaphragm. The scratch travels along and around the cylinder, its depth being controlled by the movement of the diaphragm, which is caused to vibrate by the pressure of the sound waves as the voice tube is spoken into.

If subsequently the groove is gone over again by a similar point connected to a diaphragm, the latter will be forced by the shape of the scratch to vibrate in a way similar to that in which it did when the recording was being made, the vibrations creating similar sound waves to those which originally fell on it. Some types of dictaphone have an electrical amplifier to make the record give a louder reproduction. The dictaphone is valuable for office work, in that

letters, etc., can be dictated at high speed and typed at leisure elsewhere.



Modern office dictaphone

DIDO, in CLASSICAL MYTHOLOGY is Queen of Carthage who, according to VIRGIL, destroyed herself on a funeral pile when deserted by AENEAS, with whom she had fallen in love.

DIET All foods can be grouped under three main headings: carbohydrates, fats, and proteins. A normal diet must contain enough of each, together with the necessary mineral salts, vitamins and water. Carbohydrates are substances containing starch or sugar; examples are bread, rice and other cereals, potatoes and honey. Fats and oils are present in butter, meat fat, and oils such as cod-liver or olive oil. Proteins are found in lean meat.



OLIVER TWIST ASKS FOR MORE



MR PICKWICK IN SPORTIVE MOOD

Many of Dickens's characters are familiar to boys and girls as well as their



DAVID COPPERFIELD MEETS THE MICAWBER FAMILY



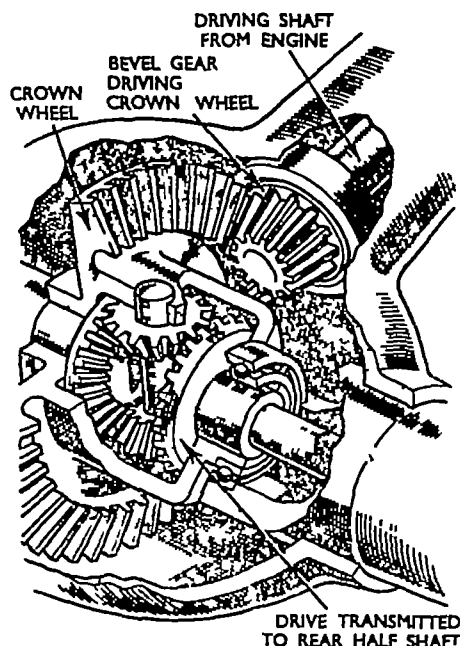
PIP IS FRIGHTENED BY THE CONVICT

parents Here are some famous incidents from four of his best-known works

ese and beans
three types of
es, and fats, after
sed for producing
gy in the body, and
necessary to form new
to cause growth Mineral
iron, calcium, phosphorus,
and others, are essential to
bones, blood, teeth, etc , they
re present in green vegetables,
fruit and other common foods
Water forms a large part of the
body weight, and since it is regu-
larly lost in breath, urine and swcat,
it must be replaced Some roughage
(the non-digestible part of foods)
is necessary to give bulk to waste
matter passed from the body

See also DIGESTION and VITA-
MINS

DIFFERENTIAL GEAR. When
a car is turning a corner the outside
wheels have to turn more rapidly
than the inside wheels The back
wheels therefore must not be
rigidly joined on one axle The
differential gear is in the middle



Differential gear of a car

of the back axle, where the driving
shaft from the engine rotates the
crown wheel which turns the back
wheels of the car By an arrange-
ment of gear wheels, the differential
gear allows each half shaft of the
rear axle to rotate at different
speeds

DIGESTION. Food is needed to
supply energy for HEAT and move-
ment, and to make new body tissue,
both to repair worn-out parts and
for new growth Food must be
broken up, and, as it passes down
the digestive tube, chemically
changed until it is in a form which
can be absorbed into and used by
the body

Food chewed in the mouth is
mixed with spittle (saliva) from
glands, and this begins the series
of chemical changes These con-
tinue in the stomach, where muscu-
lar walls churn the food, and
gastric juices are poured on to it
Here the contents must be acid for
the necessary changes to take place
The full stomach stretches, and the
contents do not pass on till they
are a sufficiently changed liquid
Some foods stay only three-quarters
of an hour, others need three hours
or longer Duodenum walls, liver
and pancreas all give out digestive
juices, each affecting a particular
part of the food When food
reaches the ileum it is ready for
absorption, and passes through the
walls into blood-vessels and other
tubes The colon walls absorb
water, and bits of food which can-
not be digested, like tough vege-
table fibres, pass on to the rectum
The journey takes from eight to
eighteen hours Undigested matter
is passed out when the circular
muscle at the anus is relaxed about
once or twice a day See also
ALIMENTARY CANAL

DIGGING the garden is neces-
sary to loosen the soil This im-

proves the value of the plant foods in it and permits the sun, air and wind to mingle with it and so increase its fertility. It is better to use a spade than a fork for digging new land. The spade must always be pressed into the ground vertically and not slantwise so that the soil is broken up to the full depth of the spade blade. This is called digging one spit deep. See ALLOTMENT GARDENING and DOUBLE DIGGING.

DISBUDDING is the removing of most of the flower buds from certain types of growing plants in order that the full effort of growth shall go into the remaining buds and thus produce larger and better flowers.

DISCIPLE means "learner," and is applied to those who learn from a great master. The twelve APOSTLES whom JESUS called to be with him are called disciples, as are also the seventy he sent out to preach.

DISRAELI, Benjamin (1804-1881), statesman and novelist of the 19th century, was a Jew by birth, but was baptized into the Christian Church. He entered Parliament in 1837, and nine years later became leader of the Conservative Party. He was three times Chancellor of the Exchequer, in 1852, 1858-1859, and 1866. He was Prime Minister in 1868 and again in 1874-1880. His most notable achievements were the Proclamation of Queen Victoria as Empress of India in 1876, and the purchase on behalf of the Government of half the shares in the SUEZ CANAL Company which safeguarded Britain's control of the Canal and the way to India. He was created Lord Beaconsfield in 1876, and died in 1881 at the age of seventy-seven.

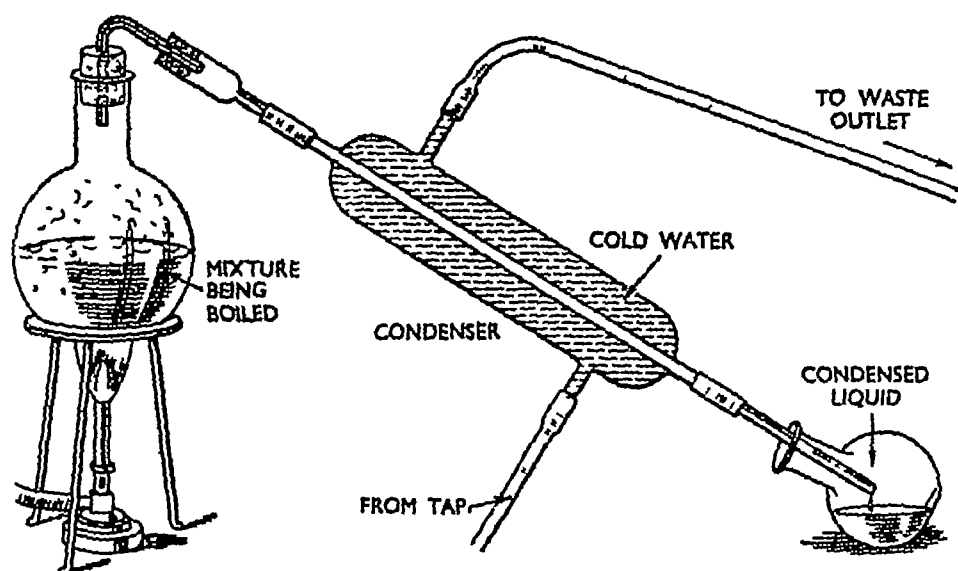
DISSENTER, one who does not accept the teaching of the Church of England. See NONCONFORMIST.

DISTILLATION is a process for the separation of substances (often in liquid form) which depends upon the fact that one or more of them evaporates at a lower temperature than the others. It entails the converting of liquid into vapour and then the condensing of the vapour into liquid again. Sometimes some of the substances may have so high a boiling point that in practice they cannot be evaporated at all. It was a common process with the ALCHEMISTS, who used it to obtain from their mixtures the more volatile "spirits" or "essences." It has also been used for a long time to obtain strong alcoholic liquors such as whisky from others which contain only a small percentage of alcohol.

A simple type of distillation apparatus is shown in the illustration on p. 178. Imagine the retort to be half filled with a mixture of alcohol and water and heated by the flame beneath. As the contents get hotter the alcohol, which boils at



Disraeli as a young man



Simple distillation apparatus for separating liquids

about 80 deg C, starts to evaporate rapidly, and finally to boil. The hot vapours pass down the long tube, which is usually cooled by water. By the time they have reached the end of the tube they have condensed to liquid again and flow into a suitable vessel. The liquid in the boiler gets weaker and weaker in alcohol until finally its boiling temperature is nearly that of water, 100 deg C. The vapours coming off are now mostly steam. The heating is now stopped and the liquid in the receiver—mainly alcohol—is removed for further treatment. By such means the alcohol can be separated entirely from the water. A process similar to this is used for the production of distilled water, petrol, and perfumes.

A variation of the simple distillation process is known as vacuum distillation. If the air pressure on the liquid is reduced by suction with a pump, the liquid will boil at a much lower temperature than normally. This is very useful for distilling materials such as sugar and glycerine, which are damaged or destroyed by prolonged heating

at temperatures near their boiling points under normal pressure.

There is yet another important type of distillation, called destructive distillation, in which we deliberately break up the substance in the retort by heating and then condense the volatile products of the reaction. For an example see COAL DISTILLATION.

DIVIDEND has many meanings: (1) It is the amount of money which is distributed to the shareholders of a company. This will depend on the type of SHARE held. The Preference Shareholder will receive a fixed return. The Ordinary Shareholder will receive a dividend that will vary with the profit of the company. The return to the Debenture holder, although called a dividend, is not strictly such; it is a fixed interest on the amount of money he has lent to the company. (2) In the case of the CO-OPERATIVE, profits are divided among the regular customers; these profits are called the dividend. When a Co-operative declares, for example, a dividend of 2s in the £, it means that for every £'s worth of goods bought, the

customer will receive 2s (3) The word is also used to mean the return given to a creditor from a bankrupt estate For example, if a person or a company has gone bankrupt for £1,000 and has assets of £100, then the creditors will receive a dividend of 2s in the £

DIVISION (—) is the opposite of multiplication $37 \times 8 = 296$, $296 \div 8 = 37$, and $296 \div 37 = 8$

(1) To divide 53,967 by 7, proceed as follows
 7 into 53 is 7 and 4 over, write 7 under 3 Write a small 4 before 9, 7 into 49 is 7, write 7 under 9 7 into 6 is 0 and 6 over, write 0 under 6 and a small 6 before 7 7 into 67 is 9 and 4 over Write 9, remainder 4 (the 4 over can be divided by 7 to make $\frac{4}{7}$)

(2) 79,639 — 58 Write out as in the example First divide 58 into 79, answer 1. Write 1 over the 9, and subtract 58 Bring down the next figure, 6 This gives 216, to be divided by 58 58 is nearly 60 supposing the divisor is 60, 6 will go into 21 three times Try 58×3 , and the answer is 174, which when subtracted from 216 gives a remainder of 42 (If the remainder were over 58, the figure would be 4, not 3) Write 3 over the 6, subtract, bring down the next figure, and go on till all the figures have been brought down In this case there is a remainder of 5

(3) The bar in a fraction means "divided by", and we can write division sums as fractions Thus $840 \div 14 = \frac{840}{14} = 60$

(4) How many lengths of 1 foot 7 inches can be cut from 33 yards?

That is the same kind of sum, but we must bring everything down to the same kind of unit

$$\begin{array}{r} 33 \text{ yards} = 1188 \text{ inches} \\ 1 \text{ foot } 7 \text{ inches} = 19 \text{ inches} \\ 1,188 \div 19 = 62 + 10 \text{ over} \end{array}$$

 There are 62 lengths of 1 foot 7 inches, and 10 inches left over

How many toys at 3s 8d each can be bought for £3?

$$\begin{array}{r} £3 = 720d \\ 3s \text{ } 8d = 44d \\ 720 \div 44 = 16 + 16 \text{ over} \end{array}$$

 16 toys can be bought, and 16d (= 1s 4d) is left over.

DOG. The dog family includes wolves, foxes and jackals, relations of the domestic dog All have blunt claws with no sheaths They run swiftly and catch their prey with their teeth Different kinds of wolf live in north-east Europe, Siberia, India and North America, some hunt in packs and others are solitary Jackals are common in many parts of Asia, Africa and south-east Europe, and these thieving carrion-eaters may occur in such numbers as to be a pest Foxes leave on their trail a strong scent from glands in their feet The British fox lives on rabbits, birds and smaller animals, and steals poultry It lives in earths in woodland, often using homes dug by badgers, and is well known for its cunning Dogs were domesticated



Jackal, one of the dog family

by man in prehistoric times, probably from small wolves. Numerous types have been bred for watchdogs, hunting, retrieving, herding sheep and guarding them where necessary, for pulling sledges or carts, or as pets. See TRANSPORT.

DOG AS A PET. If your dog is large he will have to sleep in a kennel, but do see that this is roomy enough, waterproof and quite free from draughts. If your dog has to spend a lot of time on the chain, he should have a wooden platform, a few inches off the ground, placed in front of his kennel to lie on. Indoor dogs need a basket of their own, out of draughts, off the floor, and with plenty of straw or old blankets.

All dogs, even little ones, need lots of exercise. They should never be chained up for long periods unless absolutely necessary, and they must be given regular walks. Don't expect your dog to run behind you on your bicycle. It is bad for his heart.

Puppies need small quantities of food every two or three hours, but a full-grown dog should have one good meal a day—and no scraps

or titbits at odd intervals! Give him table scraps, cooked liver or other meat, fish occasionally, porridge, vegetables and gravy and so on at midday and a hard, dry biscuit before bedtime. Keep his drinking bowl always full of fresh water. Give him a mild laxative from time to time and keep a worm powder handy while he is a puppy.

When training a young dog to do anything, make your lessons short and frequent and always use the same words of command.

Groom him daily with a stiff brush. Baths should be infrequent.

Exercise, comfortable sleeping quarters, sensible food, companionship and again exercise should keep your dog happy and healthy. If he is not, consult a vet.

DOGFISH. See SHARK.

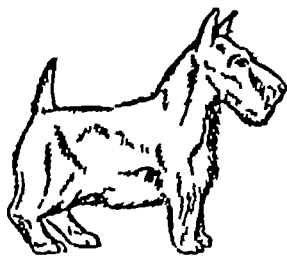
DOLDRUMS, regions of calm sea near the EQUATOR, where heated air tends to rise vertically and there are no strong winds. As it ascends, the air cools and its moisture condenses, and heavy rains result.

DOMESDAY BOOK. See WILLIAM I.

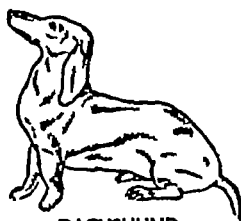
DOMESTIC ANIMALS. From prehistoric times man has trained animals for his use, as beasts of burden, to guard his home, or to help him catch food. First local animals were used, such as reindeer in the north, and camels in deserts, but later man exported animals to places where he needed them, as the Spaniards took horses to America. More recently numerous types have been bred by artificial selection, so that forms very different from their ancestors, suited to particular regions or reared for one special purpose, are produced. Sheep with very



Your dog is a true friend



SCOTTISH TERRIER



DACHSHUND



PEKINESE



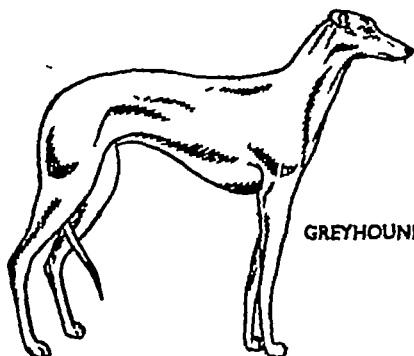
SEALYHAM



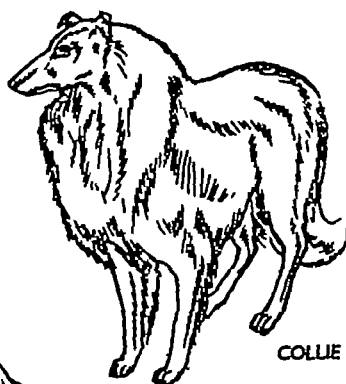
BULLDOG



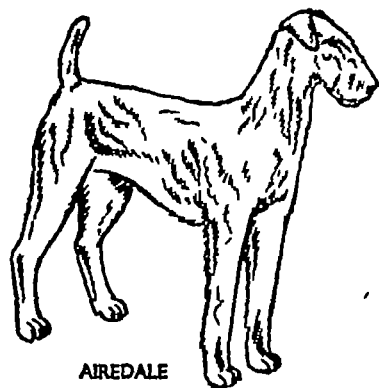
FOX TERRIER



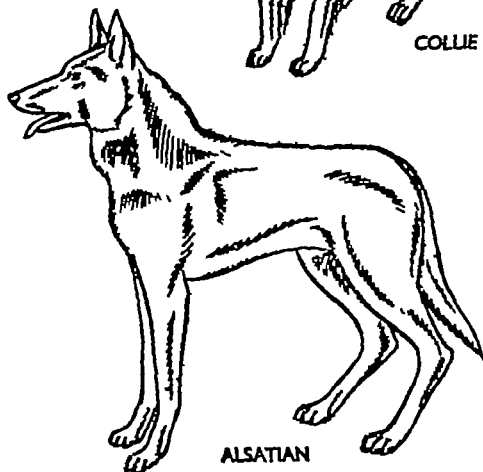
GREYHOUND



COLLIE



AIREDALE



ALSATIAN

Man has domesticated the dog and bred different types for different purposes

short legs or with very long fleece, cows with exceptional milk yield, or hens with abnormally large egg production have been bred. In the future far more specialized varieties of domestic animals will probably be produced.

See also **TRANSPORT**

DOMINICAN REPUBLIC. See **HAITI AND DOMINICAN REPUBLIC**

DOMINIONS, self-governing nations in the **BRITISH COMMONWEALTH**. Each is governed by a parliament and has a Governor-General appointed by the King on the advice of the Dominion Government.

DOMINOES is a game for two or more players, played with 28 pieces ("bones") made of black wood or white bone with spots of contrasting colour on one side. The spots are in two sets and range from 0 to 6 (to 9 with larger sets). The bones are known as 6-5, 4-0, double 2, etc., according to the numbers of spots. The dominoes are mixed face downwards, each player takes 5 or 7 bones. The first player after examining his bones places one face upwards and the next player must join one of his on, matching one of the numbers of his domino with the projecting numbers of a domino already there. Whenever a player is unable to do this he takes dominoes from the pool of remaining bones until able to do so. The first player to get rid of all his bones is the winner.

Another game is to get multiples of 5 or 3 as the combined total of the spots at the two ends, the player scoring a point every time he does that with his domino.

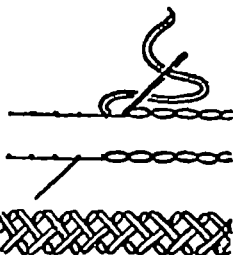
DOSTOEVSKY, Feodor (1821-1881), the most sombre of the great Russian realistic novelists of the 19th century. Suffering, sin and redemption are the themes of his greatest works *Crime and Punishment*, *The Idiot* and *The Brothers Karamazov*.

DOUBLE BACK STITCH is a useful stitch consisting of two rows of back stitch worked at the same time. Begin on the bottom line at the right-hand side, make a back stitch and bring the needle out on the top line diagonally.

Work the next back stitch on the top line, cross behind again to the bottom line, and so on. The back of the work will show a line of closed **HERRINGBONE** stitches. Alternatively a line of closed herringbone stitches will produce on the reverse side a line of double back stitching. It is used mainly for embroidery on transparent materials.

DOUBLE BASS, the largest and deepest instrument of the **VIOLIN** family.

DOUBLE DIGGING. The top layer of soil is the most fertile, but in order to improve drainage and make it easier for plant roots to penetrate, it is also necessary to break up the subsoil. Double digging serves this purpose. A line is stretched down the middle of the plot to divide it into two equal portions. A trench one spit deep



Double back stitch and its reverse



How the dominoes fit together in the course of play

(see DIGGING) is made at one end of the first portion, and the soil removed from it is taken to the end of the second portion. The bottom of the trench is loosened with a fork and manure or compost thrown in. A second trench is then opened next to the first and the top spit from it is used to fill up the first trench, the sub-soil of this second trench being loosened and compost added. This is continued until the whole of the two plots have been trenched and the soil removed from the first trench used to fill up the last one.

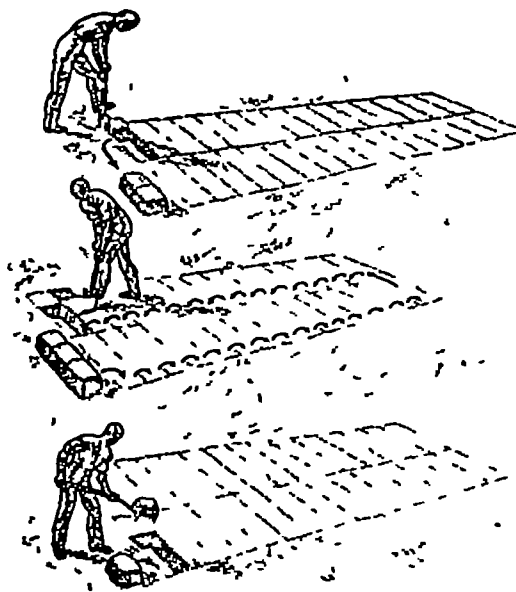
See also ALLOTMENT GARDENING and DIGGING

DOVE and PIGEON.

The wood-pigeon or ring-dove breeds in both Central London and secluded woodlands, and vast flocks migrate to Britain from Europe



Dragon fly and its larva



Method of double digging

They do great damage by eating corn and other crops. Stock-doves, turtle-doves and rock-doves also breed in Britain. Many tame varieties, such as fantail and pouter pigeons, have been bred from wild species. The homing ability of carrier pigeons is utilized in war. See also PIGEON AS A PET.

DOYLE, Arthur Conan, Sir (1859-1930), gave up his medical practice for story telling and created the most popular detective in fiction, Sherlock Holmes. He also wrote historical novels, among them *Micah Clarke*, *The White Company* and *The Exploits of Brigadier Gerard*.

DRAGON-FLY, an INSECT order whose larvae live in water, catching water animals by pincer-jaws which are folded up to mask the mouth when at rest. Full-grown larvae, showing small wing-cases, climb up water plants into the air, dry and split, and the brilliant shimmering-winged dragon-flies emerge. They are useful to man as they eat many flies and mosquitoes.

DRAKE, Francis, Sir (1540-1596), Elizabethan admiral and explorer. He was the first Englishman to go round the world See ELIZABETH and EXPLORATION.

DRAMA is religious in origin, and the earliest European drama was that of Greece Greek drama contained little action on the stage, violent events—and they were many in the legends which were the subjects of Greek tragedy—being narrated in long speeches, not enacted The chorus, generally a group of old men, provided a running commentary on what was happening, and was a necessary part of all Greek drama Roman drama imitated Greek, but was not a very important part of Latin literature Acting, as we understand it, was unknown, Greek actors wore masks representing the types of character they were playing

After the Roman Empire broke up, we hear little of drama for some centuries In medieval England it developed anew, growing out of the ceremonies of the Church These ceremonies, and the more elaborate little plays growing out of them, were an attempt to teach the Bible story by means of acting it The church services were in Latin which the simple congregations could not understand, but the series of playlets called mystery or miracle plays presented the story of the Old and New Testaments in English and were at once an instruction and a welcome show the various guilds of craftsmen, such as goldsmiths, bakers, butchers, etc., made themselves responsible (at first under the guidance of the clergy) for the acting and equipment of individual playlets, such as that of *Abraham and Isaac*, *The Building of the Ark* or *The Last Supper* The plays were performed on movable stages, called *pageants*,

and on holidays like Easter, Whitsuntide, and, in particular, the festival of *Corpus Christi*, the people would assemble at various points to which the pageants would come one by one during the day, each in turn giving its play and then moving on to the next audience Thus all the people could see all the plays A still further development was the morality plays in which virtues and vices were the characters, a celebrated example being the play of *Everyman*, a symbolical representation of man's journey through life and struggle between good and evil Later, in the 16th century, another type of drama appeared—the interlude, which was a short play, often humorous, intended for entertaining guests in the houses of the wealthy, or at court In the reigns of Elizabeth and James I a special kind of play, the masque, enjoyed a great vogue at court It contained much music and dancing, with elaborate scenery and costumes, indeed, the masque is a combination of play, opera and ballet Thus drama developed in England from the Bible stories, through moral tales about personified virtues and vices, and at last to stories about real men and women—historical drama From that it was only a step to stories about *imagined* men and women and their problems. The last two types flowered in Shakespeare's works

There are two broad divisions in drama tragedy and comedy. *Tragedy* deals with serious or sorrowful subjects with disastrous ends for some of the characters, whereas *comedy* represents amusing or foolish people, complicated situations and a happy conclusion. In tragedy we are filled with a sense of life's mystery—its chances and changes and difficulties in comedy

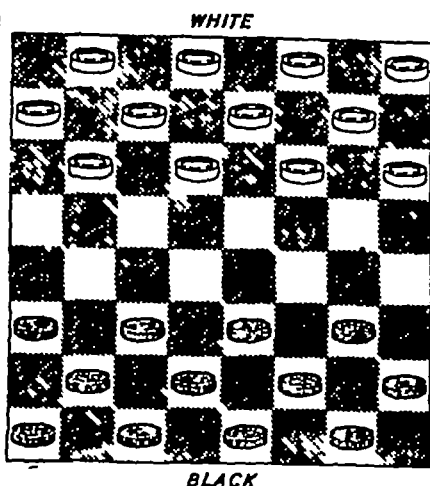
we are made to laugh at men's follies and thereby, perhaps, we help to mend them

Special names are given to special types of play. A *farce* is a comedy intended only to amuse, containing ridiculous situations and far-fetched characters

A *melodrama* is a tragic subject treated superficially with a highly sensational plot and a violent ending for the villain. *Pantomime* is a special type of spectacular drama in which some story, usually a fairy tale, is dramatized and at the same time burlesqued by the introduction of clownish characters and topical humour, dancing and singing. See also THEATRE

DRAUGHTS is a game for two players, played on a board with twelve white men against twelve black men, the men consisting of wood or bone disks. The men are set out as in the diagram, being placed on the squares of one colour only, black or white, and they keep to that colour of square throughout the game. The object of the game is to "take" the opponent's men and remove them from the board, or confine them so that they cannot move. If a player finds that he has lost all his pieces, or is unable to move them, then he has lost the game.

The player with the black men moves first, then his opponent, moving forward diagonally one square at a time to a vacant square, but if a man reaches the opponent's back line it becomes a "king" and can move in any direction. To take an opposing piece on an adjoining square, the playing square immediately the other side of the opponent's piece in a direct diagonal line must be vacant, so that the player's man can jump over. If a player can do this to more than one of his opponent's men, jumping over one



Draughtsmen ready for play

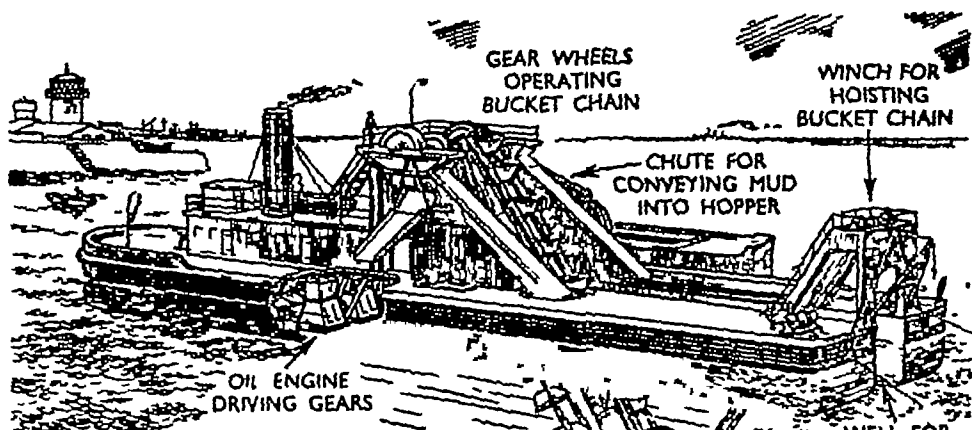
man each time into a vacant square, then he can take them all in the same move. Should a man neglect to take an opponent's piece when able to do so, that man may be "huffed" by being removed from the board.

DRAWING is part of all the visual arts and, on its own, is one of the most universal of the fine arts. See ART

The materials used today are many and varied: chalks, crayons, charcoal, pens, pencils and brushes, and for ETCHING and engraving needles, gravers and chisels. Most drawings are done on paper, white or tinted, or on thin prepared cardboard.

To draw really well, the student has to observe continually, and learn to draw what he has seen. This practice enables him to simplify and stylize his work, and to draw from memory and imagination.

Besides drawing outline shapes and details, the artist may also express solid forms in drawing. This is done by shading, or suggesting the shade or tone of the surface he wishes to indicate. There are various ways of doing this by lines



Dredger shifting mud



DRUM. See PERCUSSION INSTRUMENTS

DRYDEN, John (1631-1700), was poet, critic and playwright

In 1663 he married Lady Elizabeth Howard, and in 1668 was made Poet Laureate. Between 1665 and 1681 he wrote some fourteen plays, chiefly tragedies, the best are *The Indian Emperor* (1665), *Aureng-zebe* (1676), and *All for Love* (1678). He wrote most of his plays in rhymed verse, although *All for Love*, his best play, on the story of Antony and Cleopatra, is in blank verse. His critical work is chiefly contained in the prefaces to his works, and in the *Essay of Dramatic Poesy*.

Dryden twice changed his politics and his religion and so had many enemies. But being a man of great argumentative and satiric power, he was well able to defend himself from them.

DRYPOINT. See ETCHING

DUCK, with the goose and swan, are BIRDS which all have webbed feet for swimming, long necks and broad beaks toothed at the sides to

drawn at various distances apart, or by the use of heavier or lighter strokes. Sometimes the lines are crossed at an angle, and, to suggest roundness, may be curved according to the direction of the surface. In drawing with soft chalk, or charcoal, or with a brush, tone may be suggested by thin or broad strokes or masses. Nearly all Eastern drawing is done with the brush, and we are today inclined to the view that the best way to learn to draw is to begin with the brush.

Some of the finest drawings by great masters such as Botticelli, Michelangelo, Leonardo, Raphael, Holbein, Durer, may be seen in the British Museum and at Windsor Castle.

DREDGING is a means of maintaining or increasing the depth of a stream or harbour by removing the mud deposited by currents, thus enabling vessels to move over the area. Special ships called dredgers either suck up the mud through pipes by means of large pumps or scrape it off the bottom with huge buckets. The mud is then dumped into barges alongside and taken away.

DROMEDARY See HOOFED MAMMALS

DRUIDS See BRITONS (ANCIENT)

filter insects, water-snails and plants from mud and water. At breeding time males of the duck and goose have more brilliant plumage, as is shown by the common wild duck or mallard. Many wild species of duck and goose migrate through Britain, and numerous domestic varieties have been bred from some of them. See pictures on p. 77.

DUCKBILLED PLATYPUS, with the ECHIDNA, is the most primitive MAMMAL, for, while possessing warm blood and fur, and producing milk for its young it is also hatched from an egg. It lives in Australia.

DUET, a musical work for two performers.

DUGONG, a marine MAMMAL, from five to fifteen feet in length,



Dugong likes warm water

which is found in the Red Sea, the Indian Ocean, and along the north-east coast of Australia. It floats half-upright, with its baby under its flipper, and is thought to be the origin of stories about the MERMAID.

DUMAS, Alexandre, the elder (1803-1870), was the writer of innumerable highly coloured historical and romantic novels, of which *The Three Musketeers* and *The Count of Monte Cristo* are the best known.

DURALUMIN is an ALLOY of aluminum, copper, magnesium, silicon and manganese. Light yet strong, it has the valuable property of being temporarily very soft after

it has been heated. While thus soft it can be pressed into any desired shape, subsequently becoming rigid in its new form. It is very widely used in the manufacture of aircraft components.

DUTCH ART. See ART.

DYE is a material which penetrates and colours the fibres of fabrics. A good dye should neither fade in sunlight nor dissolve in any common liquid after it is inside the fibre. Many dyes are complex chemical substances derived from COAL DISTILLATION.

See also ANILINE.

DYKE (dike), a ditch of any size used for the draining of land, also an embankment built on either side of a waterway in which the water-level is often above the level of the land beyond the embankment, and without which the land would be flooded. The best-known dykes are found in Holland and the English fens. In Holland, in particular, whole areas have been reclaimed from the sea by means of dykes and made fit for cultivation.

DYNAMICS is the study of forces and bodies in motion.

DYNAMO. See GENERATOR.



Dumas, French novelist

EAGLE, a large BIRD of prey, with hooked beak and curved talons used to catch small mammals or birds. Golden Eagles still nest on rocky ledges in the Highlands of Scotland.

See picture on p. 76

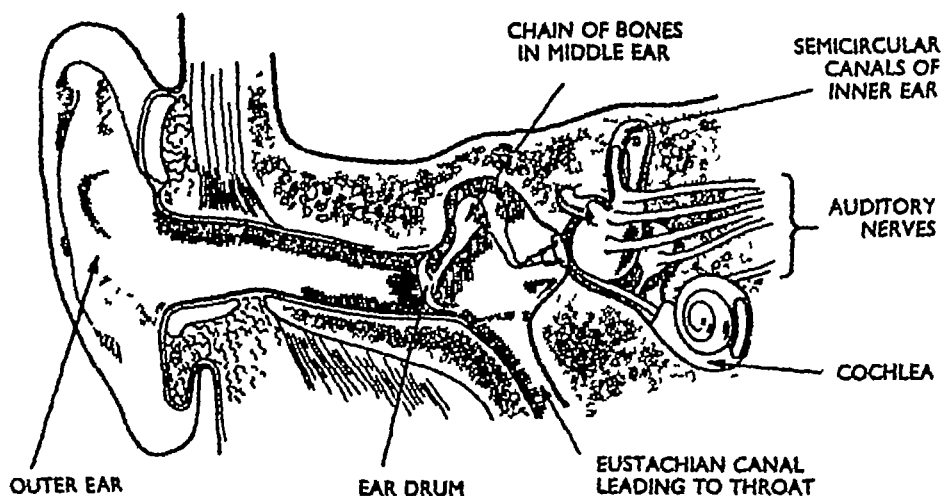
EAR. In MAMMALS the ear is concerned with both hearing and the sense of position and balance, and has outer, middle and inner ear regions. The outer ear includes the visible ear-flap (small in man, but large and mobile in horses, rabbits, etc.), and the ear tube leading to the ear drum, a tightly stretched membrane. The middle ear is an air-filled cavity, communicating with the throat by the Eustachian canal. Three little bones, the hammer, anvil and stirrup, reach across it from the ear drum to a window leading to the inner ear. This is a fluid-filled cavity in dense bone. In it is a tube coiled like a snail shell, the cochlea, which is responsible for hearing. Balance is maintained by the semicircular

canal region. Three canals lie at right angles to one another, and minute particles in the fluid within them press on sensitive hairs when the position is changed.

The ear-flaps collect SOUND waves, which cause the ear drums to vibrate. The vibrations pass through the three middle ear bones to the window of the inner ear, and thence to the fluid in the semicircular canals and cochlea.

From these, nerves take messages to the brain, where they are interpreted.

EARTH, THE. Points of scientific interest about it are (1) Its shape—a very slightly flattened ball. (2) Its size—about 8,000 miles in diameter, and about 25,000 miles in circumference. (3) Its weight—about six thousand million million million tons. (4) Its motion—it turns on its own axis once a day and travels on a nearly circular course round the sun at a mean distance of 93 million miles in 365½ days at a speed of 17 miles a second.



The ear collects sound waves, which vibrate the ear drum—these vibrations pass to the brain which interprets them.



Map of the East Indies, a string of rich tropical islands

(5) The chemical composition of its crust, which is all we can examine at present—by weight nearly half of it is oxygen, more than a quarter is silicon, with aluminium, iron, calcium, sodium, potassium, and magnesium contributing over 1 per cent each. All other elements are less than 1 per cent each, many very much less.

(6) Three-quarters of the surface is covered with water. (7) It is surrounded by an ATMOSPHERE. See WORLD.

EARTHQUAKE, a trembling of the earth's crust due to movements along lines of weakness called fractures or fault lines. The tremors—sometimes capable of great damage—can be recorded on a delicate instrument called a SEISMOGRAPH thousands of miles away.

EARWIG. See COCKROACH.

EAST AFRICA consists of the independent kingdom of Abyssinia, and various colonies, mandates and protectorates, mostly British. See AFRICA, ABYSSINIA, ANGLO-EGYPTIAN SUDAN, KENYA, SOMALILAND, TANGANYIKA, UGANDA, ZANZIBAR.

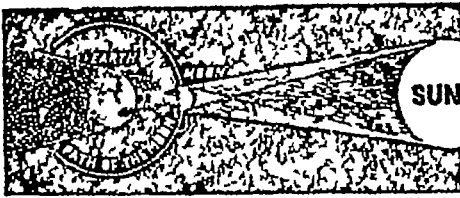
EASTER. See SEASONS OF THE CHURCH.

EAST INDIES, two main groups of islands, the Sunda group from Sumatra to Timor, and the Moluccas group from Celebes to New Guinea, with Borneo and some

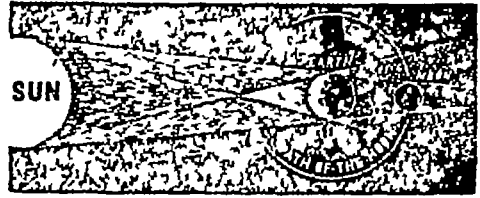
smaller islands. Except for parts of Borneo, Timor and New Guinea, these islands, formerly Dutch colonies, are combined in the United States of Indonesia, with the Dutch Sovereign at the head.

Java is the most highly developed. Sugar, tea, coffee and rubber are exported, rice is the main food crop, and has to be supplemented by imported supplies. Quinine from cinchona bark, pepper and many spices are also produced. Batavia (Djakarta) is the port for the archipelago. Sumatra is less highly developed, although there are rubber and tobacco plantations and the petroleum and tin ore reserves are being exploited. Borneo has valuable petroleum and coal reserves, but much of the island is still unexplored or inhabited by savage tribes. Plantations are more numerous in the British parts, North Borneo and Sarawak. Celebes and the Moluccas are small fertile islands in the early stages of development. The western part of New Guinea is under Dutch control, the south-east (Papua) is Australian, and the remainder is under Australian MANDATE. Thick forests cover most of the island, but some coconuts and bananas are grown and a little gold is mined. Timor is partly a Portuguese colony.

ECHIDNA (porcupine ant-eater) is, with the DUCKBILLED PLATYPUS,



Eclipse of the sun



Eclipse of the moon

the most primitive MAMMAL, it has warm blood and spines and produces milk for its young, yet it is hatched from an egg. It lives in Australia, Tasmania and Papua.

ECHO, occurs when SOUND waves strike a hard surface and are reflected backwards (just as a ball bounces back from a wall) to produce in the ear a weak repetition of the sound.

ECLIPSE. An eclipse of the sun is due to the MOON passing between the sun and an observer on the earth. It occurs around the day of the new moon. An eclipse of the moon is due to the moon passing into the shadow of the earth. It occurs at the time of the full moon.

ECOLOGY is the study of the relationships between animals and plants living in any particular region.

ECONOMICS is the study of the production and distribution of WEALTH in a community. See COMMERCE, CAPITAL, BANK, PRODUCTION, CONSUMPTION, etc.

ECUADOR, in South America, lies on the EQUATOR across the Andes. Petroleum and gold are produced. Cocoa, rice, bananas, sugar, fruit and cinchona bark are grown, and Panama hats are exported. The chief towns are the port of Guayaquil, and Quito, the capital, which lies in the Andes at over 9,000 feet above sea level, and has a fairly temperate climate. See map of SOUTH AMERICA.

EDISON, Thomas Alva (1847-1931), is the American inventor of

the gramophone and the incandescent electric lamp.

EDWARD I (reigned 1272-1307) was the son of Henry III.

His lifelong ambition was to bring Wales and Scotland under the same sovereign as England. He invaded Wales and forced Llewelyn, prince of Wales, to give up much of his territory under the Treaty of Conway (1277). The Welsh were unhappy, and soon Llewelyn and his brother, David, took up arms against Edward. Llewelyn was killed in a skirmish, and David was put to death. In 1301, Edward revived the title of Prince of Wales, and conferred it on his new-born son. The title has since been held by the British sovereign's eldest son.



Edison, American inventor

Edward did not succeed in conquering Scotland, but his repeated attacks earned him the title of "Hammer of the Scots." The death of the Scottish king, Alexander III, in 1286, followed by that of his little grand-daughter, Margaret, the Maid of Norway, left the Scots without a ruler, though there were many claimants to the throne. Edward was asked to decide between the claimants, and chose John Balliol. The Scots, fearing English interference, rose in rebellion but were defeated by Edward at Dunbar, and the Scottish crown and coronation stone were taken to London (1296). Another rebellion under William Wallace followed, and the English were defeated at Stirling Bridge (1297). Edward again led an army into Scotland, defeating Wallace at Falkirk (1298). The Scottish patriot was not captured until 1305, when he was put to death as a traitor. But another leader took his place—Robert Bruce, descendant of a Scottish king. For the last time the old King Edward I marched north, but died at Burgh-on-Sands, near Carlisle.

EDWARD II (reigned 1307-1327), was the worthless son of Edward I. He was deposed in 1327, and afterwards murdered. Edward's marriage with the French princess, Isabella, gave his son, Edward III, the excuse for claiming the French crown, thus beginning the HUNDRED YEARS' WAR between England and France.

EDWARD III (reigned 1327-1377), was the son of Edward II. He was an able king, and during his reign the commerce of England with the Continent greatly increased, and her mastery over the Channel was established. There was some fighting with the Scots, but the main military activities were in France, where Edward's claim to

the French crown opened a war that continued, with intervals of peace, for over a hundred years. See HUNDRED YEARS' WAR. In the famous naval battle of Sluys (off the Dutch coast) in 1340, the French fleet was destroyed. The Battle of Crécy in 1346 was a triumph for English long-bowmen, and was followed by the siege of Calais. The surrender of this town gave the English a base on the Continent for trade or warfare till the time of Mary Tudor.

In 1348-1349 England suffered from the ravages of the BLACK DEATH which put an end to the war for a time, and resulted in many deaths and changes in labour conditions.

In 1356, the Prince of Wales (the Black Prince) won a great victory at Poitiers, in the west of France. Another period of peace followed, but war opened again with disastrous results for the English. Edward's last years were full of trouble, the Prince of Wales was stricken with a lingering disease, and unable to carry on the war, and Edward saw all the hard-won French possessions lost except Calais. He died in 1377, a few months after the death of the Black Prince, and was succeeded by his grandson, Richard II, a boy ten years of age.

EDWARD IV (reigned 1461-1483), son of Richard, Duke of York, became King of England in 1461, after the defeat of the Lancastrian king, Henry VI, at Towton, during the Wars of the Roses. Edward was only twenty years of age, and his father had been killed the previous year at Wakefield. The young king owed his victory and crown to his cousin, the powerful Earl of Warwick, who came to be known as "the King-Maker." Edward's marriage with Elizabeth Woodville angered Warwick, and he

took up the cause of the defeated King Henry Edward took refuge in Flanders, but in 1471 he returned, and defeated Warwick at Barnet, the earl was slain in the battle Edward then defeated Henry VI's queen, Margaret, at Tewkesbury, and her young son was killed in the battle Henry VI died shortly afterwards in the Tower of London

Edward reigned another twelve years and died in 1483 During his reign the first English printing press was set up by William Caxton at Westminster.

EDWARD V was only twelve years old when his father, Edward IV, died The Duke of Gloucester, the young king's uncle, placed Edward and his brother, Richard, in the Tower (1483) The two young princes were murdered, and buried under a staircase The cruel duke became king as Richard III

EDWARD VI (reigned 1547-1553), was the son of Henry VIII He became king at the age of nine His mother's brother, the Duke of Somerset, was made protector, or regent, but he was executed in 1552, and his place taken by the Duke of Northumberland Edward's reign—during the REFORMATION—was marked by two risings—a Catholic rising in the west against the new Prayer Book ordered to be used in the churches, and a rising—Ket's Rebellion in the eastern counties—against the agricultural changes, especially the enclosure of land for sheep farms Northumberland advised Edward to name his cousin, Lady Jane Grey, as his successor (she was the wife of Northumberland's son) But on Edward's death (1553), his half-sister, Princess Mary (Tudor), became queen Poor gentle Lady Jane was imprisoned in the Tower and then executed

EDWARD VII (reigned 1901-1910), succeeded his mother, Queen

Victoria, in 1901 As Prince of Wales he had been a popular member of society He had also made lengthy tours in the Empire He visited India in 1875, and on his return Queen Victoria assumed the title of Empress of India

After he became king, Edward VII paid visits to many European countries He earned the title of "Edward the Peacemaker" He was very popular in France, which he frequently visited, and he was largely responsible for the warm friendship, known as the *Entente Cordiale* ("cordial understanding"), which has continued to exist between the two countries from his time

EDWARD VIII (born 1894), eldest son of King George V, succeeded his father in January, 1936 He abdicated in favour of his brother in December of the same year He was then given the title of Duke of Windsor

EDWARD THE CONFESSOR

See **ANGLO-SAXONS** and **WILLIAM I**

EEL, a very long FISH with minute scales buried in tough, slimy skin Young eels (elvers) travel in millions up rivers, like the Severn, and reach streams, lakes and pools where they feed and grow After some years they go down to the sea again, often wriggling across fields to reach rivers All European eels swim two to three thousand miles to breed in the depths of the Atlantic south-east of Bermuda, and die The transparent, ribbon-like infant eels take more than two years to reach the river estuaries as elvers

EGG, the sex cell produced by the female, generally it must first be fertilized by a male cell or sperm before it can begin its development to form a new animal

Eggs are usually formed in an ovary, and after **FERTILIZATION**

develop into either a larval form, such as a caterpillar or tadpole, or a miniature of the parent, as in the case of reptiles and BIRDS. If the young animal is to develop fully within the egg, a large store of yolk is necessary for food. In the bird's egg the albumen (the white) is an extra food store. In MAMMALS and in certain REPTILES and AMPHIBIA the eggs are retained within the mother's body and develop there, the young being born alive.

See also FISH and SEED

EGYPT is an independent kingdom, the life of which has always centred upon the NILE, in whose flood area intensive farming is practised. Cotton is exported from Alexandria. The rest of the country is largely desert. Cairo, at the head of the Nile delta, is the capital. The important SUEZ CANAL runs from Port Said to Suez. See also ANGLO-EGYPTIAN SUDAN.

EINSTEIN, Albert (born 1879), is a mathematician and physicist. He developed the mathematical theory of relativity which bears his name, and which gave scientists



Map of Egypt and the Sudan

new conceptions of the nature of time and space.

EIRE consists of all IRELAND except Northern Ireland. Cattle are bred on the central plain, and co-operative dairying has developed in the south-west. Most of the people are small farmers. Cattle, beer, and dairy produce are exported, mainly through Dublin, the capital, to Great Britain. A hydro-electric industry is developing on the Shannon River. The chief ports are Dublin, Cobh and Cork in the east, and Galway in the west. The south-west is well known for its lake and mountain scenery. See map of IRELAND.

ELASTICITY Most solid materials if stretched or twisted tend to return to their original shape when the force is removed. If this happens, then the material is behaving *elastically*. Common



Einstein gave science new ideas

examples are rubber and steel, which if twisted or bent try to spring back to their former shape.

ELECTRICAL ENERGY UNITS. Electricity passing along a wire can be compared with water passing through a pipe. Like the flow of water, the flow of electricity can be measured as to (1) its strength or force, (2) its amount, (3) the resistance it gets from its conductor as it flows. In electricity (1) is measured by units called volts, (2) by amperes, (3) by ohms.

The consumption of electricity is measured by the watt unit, which takes account both of force and amount, its numerical value being found by multiplying voltage by amperage.

ELECTRICITY. See **CURRENT** and **ELECTROSTATICS**.

ELECTRIC MOTOR. See **MOTOR (ELECTRIC)**.

ELECTRODYNAMICS is the study of electric **CURRENTS** and their effects as distinct from **ELECTROSTATICS**, which deals with the effects of electrical charges at rest.

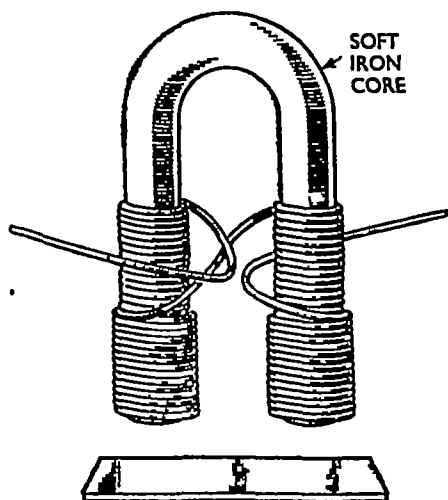
ELECTROLYSIS. When an electric current is passed through a solution of a salt such as copper sulphate, we find that the salt is

broken up into chemical substances which are deposited on the electrodes or points where the current enters and leaves the solution. This process is called **electrolysis**. Hydrogen and metals are deposited on the electrode at which the current leaves the solution, and this is used for **ELECTROPLATING** objects.

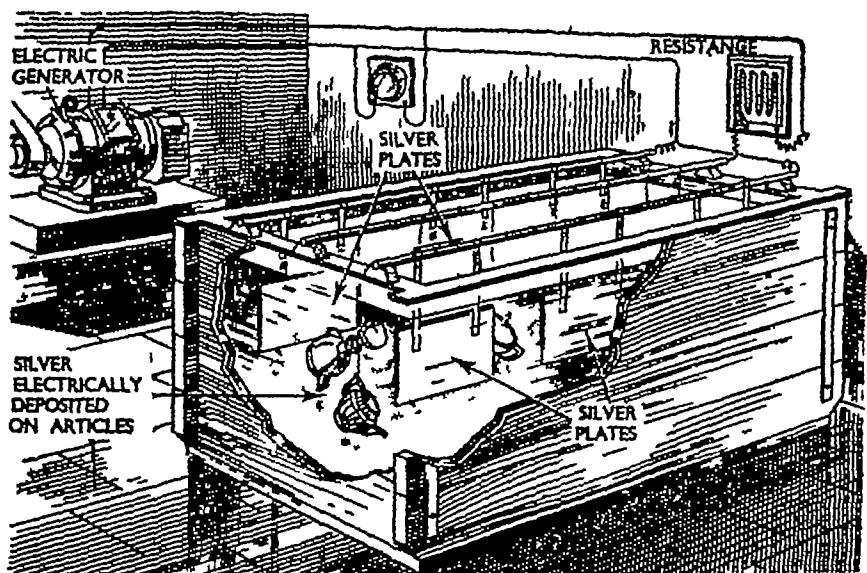
ELECTROMAGNET. Any wire carrying a **CURRENT** affects a magnetized needle placed near it. The effect is increased by winding the wires into a coil and placing the magnetized needle at one end of the coil. The effect is still further increased if a core of soft iron is placed inside the coil while the current is flowing through the wire, the soft iron becomes a strong **MAGNET** and will attract steel or iron objects. The polarity of the soft iron core depends on the direction in which the current is flowing. The iron core has often the shape of a horse-shoe. **Electromagnets** are used in **BELLS**, cranes, **DYNAMOS**, electric **MOTORS** and other electrical apparatus.

ELECTRON, the small negative elemental electric charge in the atom, which is the basis from which **CURRENTS** are built up. Through an ordinary torch bulb about three million million million electrons pass every second. See **ATOM**.

ELECTROPLATING is the use of an electric current to coat metal objects (e.g. of iron or copper) with a film of a different metal (such as silver or nickel). A bath contains a solution of a salt of the metal, say silver, which is to form the plating material. The objects to be plated are suspended from one terminal of the current, and from the other are suspended plates of pure silver on both sides of the objects. Current is passed to the silver and thence through the solution to the objects. The silver plates gradually



Electromagnet and steel object



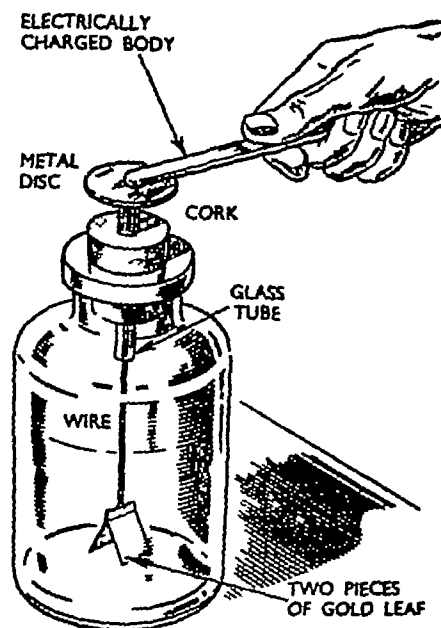
Metal objects being electroplated with silver which passes from plates to objects

dissolve and the silver passes with the current to the objects which thus become covered by a thin layer of silver See **ELECTROLYSIS**

ELECTROSCOPE. See **ELECTRO-STATICS**

ELECTROSTATICS is the study of electrical charges at rest. A body can be given a negative or positive charge in many ways, of which the simplest is by friction. If a non-conducting body such as a stick of sealing wax is rubbed on cloth, it becomes charged with electricity. This electricity is not flowing like an electric current. It is said to be at rest, and will show various effects, such as that of attracting tiny uncharged pieces of tissue paper or cotton, or of repelling bodies which have a similar kind of electricity. The electroscope is an instrument based upon this fact and used to detect the presence of electric charges. Its two leaves of very thin gold leaf are protected from draughts in a glass jar and are connected to the top metal plate by a rod or wire. When a charge is given

to this top plate by bringing near an electrically charged body it passes down to both leaves, which, charged alike, repel one another and separate. See also **CURRENT**



Simple type of electroscope

ELEMENT, a substance which cannot by chemical means be split up into different or simpler substances. There are ninety-two elements, shown in the following table. All other substances are made out of MIXTURES or compounds of these elemental substances. Below are the atomic numbers and relative weights of the atoms of the elements. Oxygen = 16 is the accepted standard; thus hydrogen is just over one-sixteenth the weight of oxygen, and carbon is three-quarters its weight.

<i>Atomic No</i>	<i>Element</i>	<i>Symbol</i>	<i>Atomic Weight</i>
1	Hydrogen	H	1.008
2	Helium	He	4
3	Lithium	Li	6.94
4	Beryllium or Glucinum	Be	9.02
5	Boron	B	10.82
6	Carbon	C	12
7	Nitrogen	N	14.008
8	Oxygen	O	16
9	Fluorine	F	19
10	Neon	Ne	20.2
11	Sodium or Natrium	Na	22.997
12	Magnesium	Mg	24.32
13	Aluminium	Al	26.97
14	Silicon	Si	28.06
15	Phosphorus	P	31.027
16	Sulphur	S	32.064
17	Chlorine	Cl	35.457
18	Argon	A	39.94
19	Potassium or Kalium	K	39.096
20	Calcium	Ca	40.08
21	Scandium	Sc	45.1
22	Titanium	Ti	48.1
23	Vanadium	V	50.95
24	Chromium	Cr	52.01
25	Manganese	Mn	54.93
26	Iron or Ferrum	Fe	55.84
27	Cobalt	Co	58.94
28	Nickel	Ni	58.69
29	Copper or Cuprum	Cu	63.57
30	Zinc	Zn	65.38
31	Gallium	Ga	69.72
32	Germanium	Ge	72.6
33	Arsenic	As	74.96
34	Selenium	Se	79.2
35	Bromine	Br	79.916
36	Krypton	Kr	82.9
37	Rubidium	Rb	85.44
38	Strontium	Sr	87.63
39	Yttrium	Y	88.92

<i>Atomic No</i>	<i>Element</i>	<i>Symbol</i>	<i>Atomic Weight</i>
40	Zirconium	Zr	91.22
41	Columbium or Niobium	Cb	93.1
42	Molybdenum	Mo	96
43	Masurium	Ma	—
44	Ruthenium	Ru	101.7
45	Rhodium	Rh	102.91
46	Palladium	Pd	106.7
47	Silver or Argentum	Ag	107.88
48	Cadmium	Cd	112.41
49	Indium	In	114.8
50	Tin or Stannum	Sn	118.7
51	Antimony or Stibium	Sb	121.76
52	Tellurium	Te	127.5
53	Iodine	I	126.932
54	Xenon	Xe	130.2
55	Cæsium	Cs	132.81
56	Barium	Ba	137.37
57	Lanthanum	La	138.9
58	Cerium	Ce	140.25
59	Præodmium	Pr	140.92
60	Neodymium	Nd	144.27
61	Illinium or Florentium	Il	—
62	Samarium	Sm	150.43
63	Europium	Eu	152
64	Gadolinium	Gd	157.26
65	Terbium	Tb	159.2
66	Dysprosium	Dy	162.52
67	Holmium	Ho	163.4
68	Erbium	Er	167.7
69	Thulium	Tm	169.4
70	Ytterbium	Yb	173.6
71	Lutecium	Lu	175
72	Hafnium or Celcium	Hf	178.6
73	Tantalum	Ta	181.5
74	Tungsten or Wolfram	W	184
75	Rhenium	Re	186.31
76	Osmium	Os	190.8
77	Iridium	Ir	193.1
78	Platinum	Pt	195.23
79	Gold or Aurum	Au	197.2
80	Mercury or Hydrargyrum	Hg	200.61
81	Thallium	Tl	204.39
82	Lead or Plumbium	Pb	207.2
83	Bismuth	Bi	209
84	Polonium	Po	210
85	—		
86	Radon or Niton	Rn	222
87	—		
88	Radium	Ra	225.95
89	Actinium	Ac	—
90	Thorium	Th	232.15
91	Protactinium	Pa	—
92	Uranium	U	238.17

AFRICAN ELEPHANT



INDIAN ELEPHANT

The two kinds of elephant

ELEPHANT, a MAMMAL reaching 11 feet at shoulder height and having a very long trunk. It is found in India and Africa. Ivory is obtained from the tusks, which are really two specialized teeth. The Indian elephant has smaller ears and a higher forehead, and is used widely for forestry haulage and in processions. The African elephant, which is less easily domesticated, has enormous ears. Both animals use their trunk for sluicing water, as a weapon or tool, and for getting food such as bunches of leaves.

ELGAR, Edward, Sir (1857-1934), was a great English composer. The first work to bring him fame was *The Enigma Variations* for orchestra. This was followed by the oratorios, *The Dream of Gerontius*, *The Apostles* and *The Kingdom*, and then by the two great symphonies,

the orchestral tone-poem *Faust*, and the concertos for violin and 'cello. The first of the "Pomp and Circumstance" marches contains the melody of "Land of Hope and Glory."

ELIJAH was a great prophet who lived about 850 B.C. and called upon Israel to follow Jehovah rather than the heathen god Baal.

ELIOT, George (1819-1880), was the pen name of Mary Ann Evans who, like the BRONTES, was unconventional enough to make a career for herself as a writer. She spent her early life in Warwickshire, and showed an eagerness for knowledge and willingness to study. In 1850 she was in London, and from 1851 to 1853 was assistant editor of the *Westminster Review*. Her first works of fiction, the short stories collected together as *Scenes of Clerical Life*, appeared in *Blackwood's Magazine*. Her reputation as a novelist was established by three novels in three years, *Adam Bede* (1859), *The Mill on the Floss* (1860) and *Silas Marner* (1861). She spent two years in Florence in Italy, and produced a historical novel, *Romola*.



Elgar, great English composer



George Eliot, novelist

Her novels show great understanding of human nature and its trials, especially of women, as well as giving a clear picture of life in rural England and its country towns

ELISHA (about 800 B.C.) was the prophet who continued the work of **ELIJAH**. His healing of Naaman is a striking story in the Bible.

ELIZABETH (reigned 1558-1603), daughter of Henry VIII, became queen on the death of her half-sister, Mary Tudor. Her long reign is one of the most remarkable in history. It was a time of great revival. The **RENAISSANCE** or New Learning aided by the printing press had swept over Europe. It was an age of **EXPLORATION**, and English seamen, Drake, Hawkins, Frobisher, Gilbert, Raleigh and others, were building up the sea-power of England. It was a time of great writers—"the golden age of English literature." Shakespeare, Spenser, Marlowe and Philip Sidney all lived in that reign.



English fire ships bear down upon the mighty Spanish Armada

Elizabeth's reign was also a time of danger. After the REFORMATION England was being threatened by the wealthiest and most powerful nation of the time, Catholic Spain. The Armada came in 1588, intending to invade and conquer England, but the skill of Drake and other "sea-dogs" was too much for the dons and sailors of Spain, and only a miserable remnant of the mighty fleet limped back to Spanish waters.

The East India Company, chartered at the end of the reign, laid the foundation of English trade and influence in the East. The attempts to colonize in the West, in Newfoundland and Virginia, were apparent failures, but were the beginnings of later successful efforts.

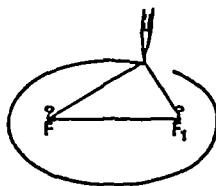
Among the great names of Elizabeth's reign are Cecil, Lord Burghley, the wise statesman who helped Elizabeth to steer the ship of state through dangerous waters, and the Earl of Leicester, the "sweet Robin," who risked much to gain the queen's hand in marriage, and failed. A woman as famous as Elizabeth herself was the cause of much uneasiness in England and Scotland. She was the beautiful MARY, QUEEN OF SCOTS, Elizabeth's cousin. For nineteen years Mary was a prisoner in England, and was the centre of Catholic plots. At last Elizabeth signed the warrant that sent her cousin to the block (1587). But it was Mary's son, James, King of Scotland, whom Elizabeth named as her successor when she lay dying in 1603. So the Union of the Crowns of England and Scotland at last took place.

ELIZABETH, Princess (born 1926), is the eldest daughter of King George VI and heir-presumptive to the Throne. In 1947 she married Lieutenant Philip Mountbatten, created Duke of Edinburgh, formerly Prince Philip of Greece.

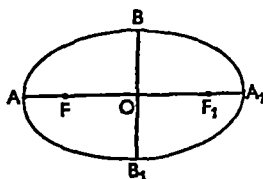


Elizabeth addresses her troops

ELLIPSE. To draw an ellipse, fix two pins upright, put a loop of thread over them, draw the thread out with the point of a pencil, and draw round, keeping the thread taut. F and F_1 , where the pins are pushed in, are called the *foci* of the ellipse. AA_1 , the diameter through the foci, is called the *major axis*. O , the mid-point of AA_1 , is the *centre* of the ellipse.



BB_1 , at right angles to AA_1 through O , is the *minor axis*.



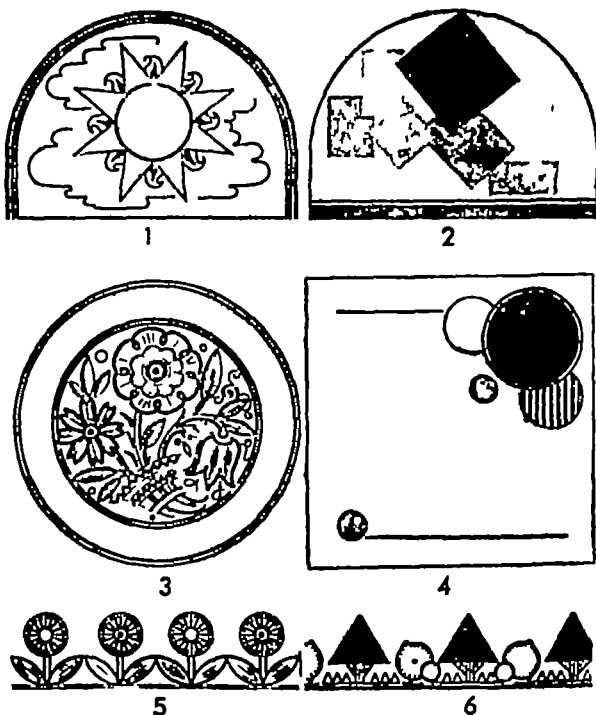
The *eccentricity* of the ellipse is a fraction which decides how far out the

focus is from the centre; the greater the eccentricity the more elongated is the ellipse it can be calculated from the semi-axes

We often write a for OA (semi-major axis), b for OB (semi-minor axis), and e for eccentricity.

ELYSIUM, or Elysian fields, is part of the underworld which is the abode of the blessed, according to CLASSICAL MYTHOLOGY

EMBROIDERY. For this it is essential to have a sound knowledge of different stitches, design and colour. Transfers can be bought, but it is more interesting to make one's own designs, however simple these may be. The use and combination of colour is also important. Keep silks and threads in good order in a case, take a length of material, sew elastic or ribbon into loops down the middle to hold the skeins in place, and keep the case thus made rolled up when not in use. Have a needlecase containing a selection of needles of different thicknesses and kinds. A pair of scissors is essential and a work apron, which can be used to wrap up the embroidery, is valuable. Among the most popular embroidery stitches are BACK STITCH, BUTTON-HOLE STITCH, CHAIN STITCH, CORAL STITCH, CROSS STITCH, DOUBLE BACK STITCH, FEATHER STITCH, FLAT STITCH, FRENCH KNOTS, HLM STITCH, HERRINGBONE, LOOP STITCH, PICOT EDGING, RUMANIAN STITCH, RUNNING STITCH, SATIN STITCH, SCALLOPING, STEM STITCH, V OR Y STITCH. See also APPLIQUE, NEEDLEWEAVING, SAMPLER and SMOCKING. Always choose a design which suits the



Some simple embroidery designs

material. Some fabrics require a bold design, in others it depends on the thread of the material. The material must be such that it is worth the amount of work put into the decoration. The decoration should emphasize the shape of the article: (1) does this, while (2) does not, (3) shows a design entirely suitable for the shape. Variety in design and colour are necessary if the result is to be interesting. Articles seen from many viewpoints should have a design which looks all right from all angles. A design which is too heavy is unpleasant. Even those who find designing difficult can make simple and effective geometric patterns. The cushion shown in (4) is decorated by a group of overlapping circles in one corner. Attractive borders made from repeating motifs are easy to work out and look well if carefully done, as in (5) and (6).

EMBRYO, the earliest stages of growth in any animal or plant,

beginning when the fertilized egg CELL divides to form two cells and finishing when the plant SEED germinates, the EGG hatches, or the MAMMAL baby is born. The human embryo may be called the foetus. See also FERTILIZATION.

EMIGRATION, leaving one's own country to settle in another. Persons leaving a country are *emigrants*, but on admission to another country they are *immigrants*. **EMPHASIS**. See IMAGERY.

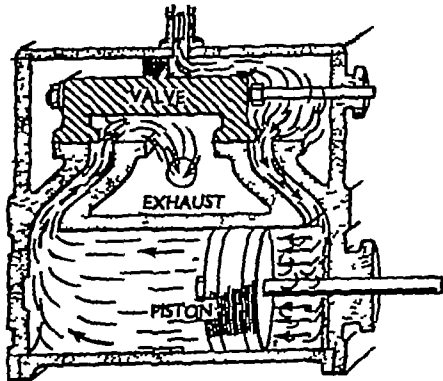
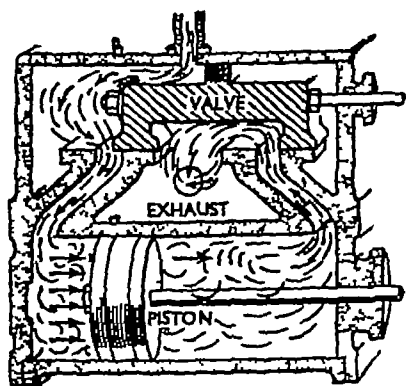
EMULSION. Oil and water will not mix alone. If, however, a quantity of soap is added and the mixture violently shaken, then the oil breaks up into minute globules each surrounded by a film of soap. This is an emulsion, and the globules stay distributed throughout the water and do not join together again and float to the top. Many toilet and hair creams are emulsions. The cleansing action of soapy water is due to the fact that the particles of dirt and grease are emulsified and swept away.

ENAMELS are glass-like materials which are applied to metal surfaces and melted or "fired" thereon to give decorative or protective effects. The name is also incorrectly given to certain paints which have a hard and glossy surface when they are dry.

ENERGY. A body or substance is said to possess energy when it can do work. Thus the energy of a moving bullet is shown by its ability to bend or tear whatever it strikes, the energy of dynamite by its shifting of heavy weights when it explodes, the energy of a waterfall in its ability to drive a turbine, the energy of the sun's radiation in its ability to ripen our food, the energy of food in its power to make us grow, move, and do things. Similarly, all forms of energy, electrical, acoustic, and heat, can be made to perform mechanical work. See also ELECTRICITY, HEAT.

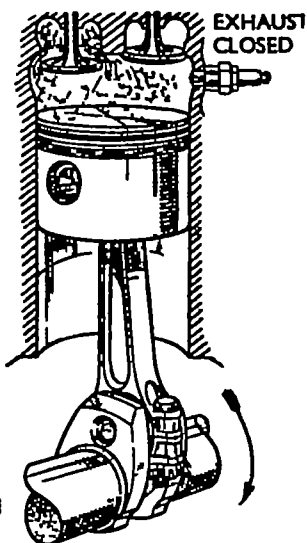
ENGINE, a mechanical contrivance, of which the two main types are as follows:

(1) *Steam engine*. There are two very different kinds of engine worked by steam—the TURBINE and the reciprocating engine. The former consists of blades on a drum pushed round by steam pressure and is used for driving DYNAMOS in power stations, and for turning ships' PROPELLERS. The illustration shows the other kind, a reciprocating engine with steam entering a cylinder and pushing a piston and its piston rod. Then by the movement of a valve, the steam enters the cylinder on the other side, and pushes the piston rod back again.



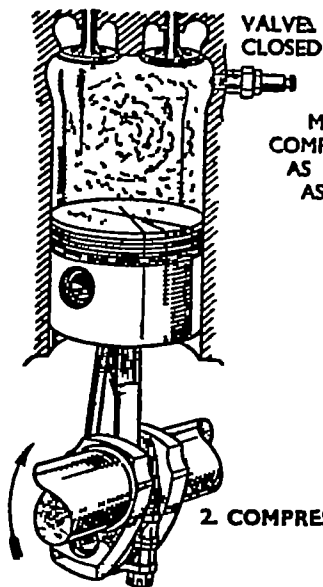
In a reciprocating engine, steam pushes the piston to and fro

INLET VALVE
OPENED
MIXTURE
DRAWN INTO
CYLINDER AS
PISTON
DESCENDS



1 INDUCTION

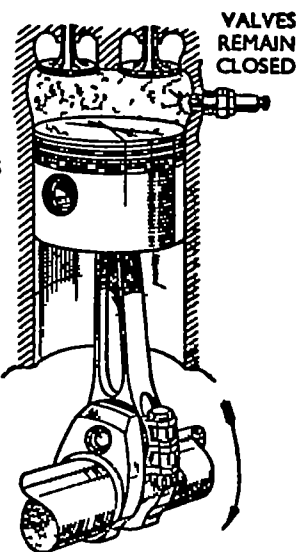
EXHAUST VALVE



VALVE
CLOSED
MIXTURE
COMPRESSED
AS PISTON
ASCENDS

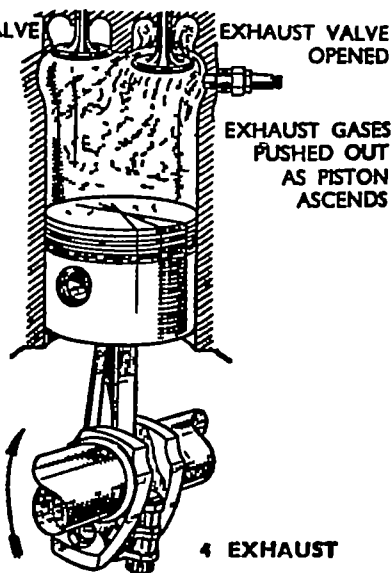
2 COMPRESSION

COMPRESSED
MIXTURE
IGNITED
CAUSING
EXPLOSION
WHICH FORCES
PISTON DOWN



3. POWER

INLET VALVE
CLOSED



EXHAUST VALVE
OPENED
EXHAUST GASES
PUSHED OUT
AS PISTON
ASCENDS

4 EXHAUST

Four-stroke internal combustion engine at work

Then the whole operation starts all over again. Reciprocating engines are very reliable and are used for locomotives and in factories.

(2) *Internal combustion engine or motor* Engines of this general type may be either spark ignition or compressed ignition engines.

In a spark ignition engine, an explosive gas of oil vapour or coal gas mixed with air is exploded inside a metal cylinder, and the

expansion of the hot gas is made to drive a piston and crankshaft. The explosive gas is formed in a device called a carburettor and is exploded inside the cylinder by a hot electric spark from a SPARKING PLUG.

The illustration shows a simple one-cylinder engine of the four-stroke type. The cycle of operations is as follows. On the "induction" stroke, the piston moves outwards in the cylinder, causing the inlet

valve to open, which admits the explosive mixture into the cylinder, when the piston reaches the end of its stroke, the inlet valve closes. The piston returns on the "compression" stroke, compressing the explosive mixture to about an eighth of its original volume, when the piston has reached the innermost point of travel, a spark from a sparking plug in the cylinder fires the gas. The high pressure so caused drives the piston out on the "power" stroke. When it returns on the "exhaust" stroke it opens the exhaust valve and drives out the used gas. The next stroke of the piston is another "induction" stroke, and so the whole cycle is repeated. The up-and-down movement of the piston rotates a shaft. As only one stroke in four gives power for driving, a heavy flywheel is attached to the shaft, and the weight of this wheel spinning round will keep up the drive during the other three strokes.

In the compressed ignition engine, the vapour is not mixed with the air until the air has become very hot from compression inside the cylinder. The injected fuel then burns easily.

See also JET ENGINE.

ENGINEER, originally a man who dealt with engines, such as the huge catapults used in medieval times or primitive cranes and GUNS. Then steam ENGINES became important in mines and mills. Next the internal combustion engine needed engineers, and power machinery used in factories to replace the old hand TOOLS was built and operated by engineers. Now we have chemical engineers who operate the chemical plants, electrical engineers, civil engineers, marine engineers, etc.

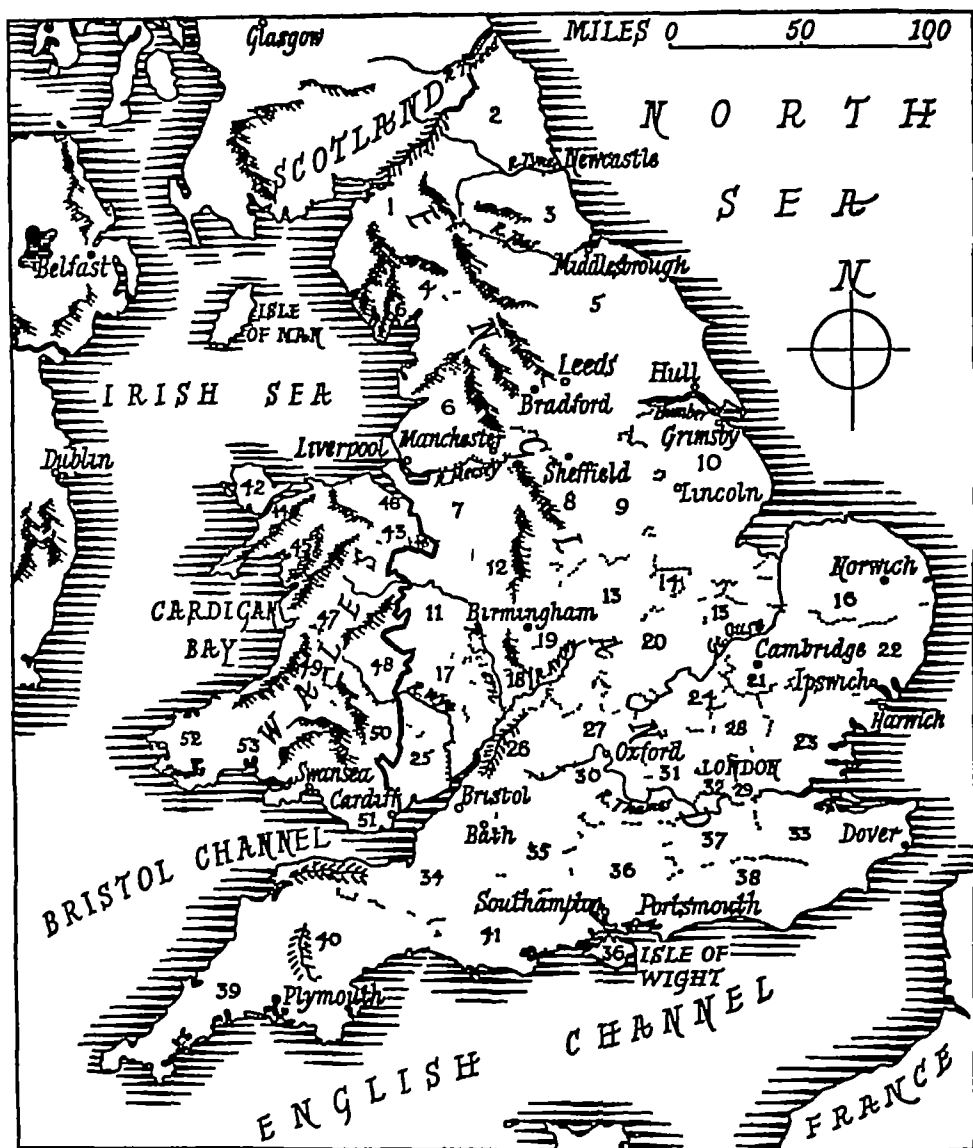
ENGLAND, the southern part of the island of Great Britain. It gets

its name from the Angles, one of the Germanic tribes which invaded the island in the 5th century (See **ANGLO-SAXONS**). Combined with Wales it remained a separate state until the union with Scotland in 1707 (See **ANNE**). The map on p. 204 shows the counties and the most important towns for further geographical information see under **BRITISH ISLES**. The various events in English history are dealt with under their respective headings.

ENGLISH ART See **ART**.
ENGLISH LANGUAGE, one of the family of Indo-European languages, which embraces the greater number of those spoken in Europe today, as well as Sanskrit and Zend, the ancient languages of Northern India and Persia. These languages became more and more different over a long period in pre-historic times. Definite changes in the pronunciation of consonants in the Germanic branch of the Indo-European languages are tabulated as Grimm's Law, after the German scholar who first classified them.

English is one of the Germanic group, evolving from West Germanic. Written Old English (see **ENGLISH LITERATURE**) represents the language before the Norman Conquest. With the invasions of the Danes and Norsemen and the Norman Conquest, a large number of new Scandinavian and Norman-French words entered the language. A fresh influx of Latin words appeared during the Renaissance. Indeed, the English language has been remarkable throughout its history for the ease with which it has absorbed foreign elements.

ENGLISH LITERATURE The beginnings of English literature are older than the actual manuscripts containing the first recorded work. The earliest of these dates back to



Map of England and Wales, showing the various counties, which are as follows—ENGLAND (1) Cumberland, (2) Northumberland, (3) Durham, (4) Westmorland, (5) Yorkshire; (6) Lancashire, (7) Cheshire; (8) Derbyshire, (9) Nottinghamshire, (10) Lincolnshire, (11) Shropshire; (12) Staffordshire, (13) Leicestershire, (14) Rutland, (15) Huntingdonshire, (16) Norfolk, (17) Herefordshire; (18) Worcestershire, (19) Warwickshire, (20) Northamptonshire, (21) Cambridgeshire, (22) Suffolk, (23) Essex, (24) Bedfordshire, (25) Monmouthshire, (26) Gloucestershire, (27) Oxfordshire, (28) Hertfordshire, (29) London, (30) Berkshire, (31) Buckinghamshire, (32) Middlesex, (33) Kent, (34) Somerset, (35) Wiltshire, (36) Hampshire, (37) Surrey, (38) Sussex, (39) Cornwall, (40) Devon, (41) Dorset, WALES (42) Anglesey, (43) Denbighshire, (44) Caernarvonshire, (45) Merionethshire, (46) Flintshire, (47) Montgomeryshire, (48) Radnorshire, (49) Cardiganshire, (50) Brecknockshire, (51) Glamorganshire, (52) Pembrokeshire, (53) Carmarthenshire See page 203

about the 9th century Anglo-Saxon, or Old English, literature contains both Christian writings and poems which in spirit are pagan, and tell of a life probably very like that led by the Saxon invaders before they came to England. *Beowulf* is the most important example of this kind of poetry.

One name in particular emerges in Old English Christian poetry—Caedmon. Bede's *Ecclesiastical History* is the source of all we know of him, and tells the story of how Caedmon, leaving a feast rather than admit that he could not compose a song, was visited by an angel who gave him the power of song.

In addition to poetry and prose in English before the Norman Conquest, there were writings in Latin. Bede, the monk of Jarrow, wrote his *Ecclesiastical History* in Latin. This was translated into English during the reign of ALFRED (about 848-901). Alfred may have written an early portion of the *Anglo-Saxon Chronicle*.

The Old English period came to an end with the Norman Conquest, which brought new tastes into literature and new words into the ENGLISH LANGUAGE. Medieval English (sometimes called Middle English) literature is much more varied. The country was more or less united under the Normans, whereas before it had been divided into a number of kingdoms in which invasions were frequent, and many manuscripts kept in monastic libraries destroyed. Greater security meant that more literary work was preserved, and men had more time for it. Many long romances in verse were written, the favourite subjects being the large number of stories collected round King ARTHUR and his Knights of the Round Table. History, almost entirely legendary, was compiled in both Latin and

English, both Geoffrey of Monmouth and Layamon (12th to early 13th centuries) recording the deeds of King Arthur. Also legendary were the *Travels of St John Mandeville* (14th century) in the Holy Land, Persia and India—much of it as incredible as it is fascinating. Popular poetry, which has survived by being handed down by word of mouth, is represented by the ballads, English and Scots. These were not written down in their present form until they were collected in the 18th and 19th centuries, but some of them, such as those on Robin Hood, or the Scots ballads of *Bannorie* and *Sir Patrick Spens*, can be followed back to the 15th century at least.

Towards the end of the medieval period particular works and writers stand out. *Piers Plowman*, attributed to William Langland in the mid-14th century, is a long ALLEGORY. The poet sees a vision of the earth and its troubles, and the corruption and laxness of the clergy. The greatest poet of the whole period was CHAUCER. *The Morte d'Arthur*, by Sir Thomas Malory (flourished about 1470), tells again in prose the long series of legends of King Arthur.

The invention of PRINTING, and its introduction into England in 1476 by Caxton, increased the output of books and made them available to more readers. From the 14th century onwards, the revival of interest in classical literature in Europe, and the stirring of thought and feeling, expressing itself in science and the arts, which is generally known as the RENAISSANCE, influenced all the civilized countries of that time. In England it bore full fruit in the latter part of the 16th century in the reign of Queen Elizabeth.

With the defeat of the Spanish Armada in 1588 England was

secured from outside attack Under Elizabeth religious controversy was for the time stilled This was the period of fresh life in literature The DRAMA flourished with playwrights such as MARLOWE and SHAKESPEARE England led Europe in music, and poetry and music were closely linked, many lyrics were written, often for a musical setting Patriotic feeling expressed itself Queen Elizabeth was the symbol of this patriotism, and writers complimented and glorified her in their works So SPENSER in his *Faerie Queene* introduces her as Gloriana, the lady to whom all the knights owe allegiance Literature now aimed at entertainment rather than instruction, and collections of romantic tales appeared, often translated from Italian With the succession of the Stuarts in 1603 there was no lessening of the output of writing, although a graver note is heard in the religious poetry of such writers as Donne (1572-1631) and Herbert (1593-1633), while drama in the hands of Ben JONSON dealt less with romantic themes and turned to London life for subjects When political and religious turmoil culminated in the Civil War, the work of MILTON shows the seriousness of the time, yet such poetry as HERRICK's retains the charm and gaiety of the Elizabethan days

After the Restoration of 1660 new tastes appeared in literature From their exile in France the king's friends brought back an admiration for French literature, especially for its correctness and attention to form DRYDEN and, in the 18th century, POPE emphasized the need for correctness and restraint in writing Very many satirical works were produced, such as those of Pope and SWIFT, intended to show society its faults so that they might

be corrected The 18th century was the time when prose developed fast, from something elaborate and cumbersome to something simple and serviceable Steele and ADDISON in their essays, intended for men and women of average education, used a simple, conversational style

Towards the end of the 18th century there was a movement away from the orderliness and restraint of Pope and his imitators Once again poets began to express their personal experience and ideas in their verse. At the turn of the 18th century a remarkable group of poets, COLERIDGE, WORDSWORTH, BYRON, SHELLEY and KEATS, were all writing The FRENCH REVOLUTION of 1789, the first of a series of revolutionary movements in Europe, stirred their imaginations profoundly Men, their ideals and struggles, and the beauty of the world around, were their themes In prose also, personal taste and experience found an expression during the ROMANTIC REVIVAL, as this period is called, in the work of essayists, such as LAMB and HAZLITT.

The interest in men and society of the 18th century showed itself in novels as well as poetry and prose satire The work of novelists such as DEFOE, Fielding and Jane AUSTEN affords pictures of English society of various ranks Sir Walter SCOTT, on the other hand, chose romantic themes and historical settings from the picturesque past

When Queen Victoria's long reign began, the excitement of the Romantic Revival had burnt out The poetry of TENNYSON and BROWNING is concerned with different ideas Browning set himself to assert a practical religion against the doubt created by scientific facts and theories at variance with Church teaching (see DARWIN) The material

prosperity of England created by the INDUSTRIAL REVOLUTION seemed to Matthew ARNOLD to produce dullness of soul, so, despairing of his own times, he looked back to the perfection of Greece. The Pre-Raphaelite writers, ROSSETTI and William MORRIS, also rebelled against the ugliness and material dullness of their times, and used colour and richly romantic themes in their writings and other artistic work.

In the novel, DICKENS aroused the imaginations of his readers by showing the effects of evil conditions on human beings forced to endure them. George ELIOT was concerned with the spiritual problems of women in particular, while THACKERAY ridiculed social snobishness.

The early 20th century, while showing nothing startling in poetry, produced a revival in drama. The influence of IBSSEN, the Norwegian dramatist, whose plays are studies of human and domestic problems, spread over Europe. Bernard SHAW's plays, shocking his audience into attention by their wit at the expense of accepted traditions, brought fresh life into the English theatre, which had shown nothing of any merit in Victorian times. John GALSWORTHY's plays dealt with social problems in a serious manner, and his novels gave a very full picture of the comfortably off middle classes. H. G. WELLS, on the other hand, introduced new themes into fiction with his scientific romances, while his novels on domestic affairs imply, or openly state, a criticism of the order of society. The poets who wrote before the First World War were, however, in the main content with traditional themes and forms. Nevertheless, with Gerard Manley Hopkins (1844-1889), experiments

with rhythm and words point forward to a departure from such traditional expression. During this time some of the most remarkable work in poetry came from Ireland, with the lyrics and poetic drama of W. B. Yeats (1865-1939) and J. M. Synge (1871-1909).

The First World War produced in its later stages, poetry such as that of Wilfred Owen (1893-1918) and Siegfried Sassoon (b. 1886), full of despair, disillusionment and anger at the waste of life and its degradation. The same feelings appeared again in the novels about the war which appeared some eight years after it had ended. After the war, the restlessness and dissatisfaction so widely felt in the years before the depression of 1929 appear in the novels of Aldous Huxley (b. 1894) and D. H. Lawrence (1885-1930). In poetry during this time there was constant experiment with form and with the possibilities of words, which frequently led to obscurity and difficulty to the ordinary reader. The work of the Sitwells and T. S. Eliot (b. 1888) in the 'twenties shows this. The same kind of experiment, especially with language, is seen in the prose writing of James Joyce (1882-1941).

Among writers whose reputations have grown with the years are Somerset Maugham (b. 1874), who has ranged the world for material, and E. M. Forster (b. 1879), a quiet novelist of middle-class life. J. B. Priestley (b. 1894), James Bridie (b. 1888), Sean O'Casey (b. 1890), and Emlyn Williams (b. 1905), hold sway in drama. Of the younger novelists Graham Greene (b. 1904), views adventurous themes from a religious angle, Eric Linklater (b. 1899), is boisterous and witty, and Rex Warner (b. 1905), thoughtful and allegorical. Of the younger

poets W H Auden (b 1907), Stephen Spender (b 1909), C Day Lewis (b. 1904), and Dylan Thomas (b 1914), are outstanding

ENTOMOLOGY is the study and classification of **INSECTS** Entomologists work to counteract damage done by insect pests to crops, wood, etc , and study life histories to find which insects are useful to man, and how to encourage them Important work on disease-carrying insects is also done

ENZYMES are certain substances secreted by living organisms which act in a catalytic manner (see **CATALYST**) to assist some desired chemical action in the body The digestive processes in the body are all controlled by enzymes secreted in the stomach and gut

EPIDEMIC, the widespread existence of an infectious disease such as typhus or influenza Epidemics have become much less severe in civilized countries since the improvement of sanitation and refuse disposal, and the isolation of sufferers They are also controlled by **INOCULATION** of people likely to be in contact with sufferers.

EPIGRAM. See **IMAGERY**

EQUATIONS are of two kinds

(1) *Chemical Equations* are a symbolic way of stating the kinds of material used and produced in a chemical reaction, e.g $\text{CaCO}_3 + \text{H}_2\text{SO}_4 \rightarrow \text{CaSO}_4 + \text{H}_2\text{O} + \text{CO}_2$ means that one molecule of chalk (CaCO_3) reacts with one molecule of sulphuric acid (H_2SO_4) to give one molecule of calcium sulphate (CaSO_4), one of water (H_2O) and one of carbon dioxide gas (CO_2) Equations tell us nothing about the conditions under which the reaction takes place nor about the other effects of the reaction (e.g heat produced) If a reaction is reversible (i.e. if the products can be acted on in a reverse way to pro-

duce the original substances) the \rightarrow sign becomes \rightleftharpoons . For symbols, see **ELEMENTS**

(2) *Mathematical Equations* An equation is a statement that two things are equal

We can show by multiplying that $(x + y)^2 = x^2 + 2xy + y^2$

That kind of equation is called an identity An identity* is true no matter what values the quantities in it may have Suppose for instance that x is 3 and y is 7.

$$\begin{aligned}(x + y)^2 &= (3 + 7)^2 = 10^2 = 100 \\ \text{and } x^2 + 2xy + y^2 &= \\ 3^2 + (2 \times 3 \times 7) + 7^2 &= \\ 9 + 42 + 49 &= 100\end{aligned}$$

so the two sides of the identity are equal An identity is sometimes written with the sign \equiv instead of $=$

$3x - 7 = 9 - x$ is an example of an equation that is true for only one value of x , when $x = 4$.

$$\begin{aligned}3x - 7 &= 12 - 7 = 5 \\ \text{and } 9 - x &= 9 - 4 = 5\end{aligned}$$

But any other value of x would make the two sides unequal

When we find the single value of x that makes an equation true we are said to have solved the equation Simple equations contain only one unknown quantity, say x (not x^2 or any other letter) and numbers A simple equation has only one solution

An equation is like a balance Without disturbing the balance we can add equal amounts to the two sides, subtract equal amounts, multiply or divide by the same number and so solve the equation

$$3x - 9 = 7x + 9$$

We want x 's on the left, so we subtract $7x$ from each side to get rid of the $7x$ on the right

$$3x - 7x - 9 = 9$$

We want numbers on the right, so we add 9 to each side to get rid of the -9 on the left

$$3x - 7x = 9 + 9$$

Simplifying, $-4x = 18$, then by

dividing each side by -4 we get

$$x = -\frac{13}{4} = -4\frac{1}{4}$$

There is a neat way of adding and subtracting quantities on both sides of an equation we can take any quantity across to the other side of an equation, *with its sign changed*

$$7 + 4x = 9 - 3x$$

$$4x + 3x = 9 - 7$$

$$7x = 2$$

$$x = \frac{2}{7}$$

We may have two unknown quantities in an equation

$$3x + 5y = 8 - x$$

$$\text{then } 3x + x = 8 - 5y$$

$$4x = 8 - 5y$$

$$x = \frac{8 - 5y}{4}$$

And that is as far as we can go We need two *simultaneous* equations to find solutions for two unknowns

$$4x - 5y = 7$$

$$3x + 8y = 17$$

We begin by getting rid of (*eliminating*) one unknown We can multiply the first equation by 3 and the second by 4, thus making x the same in both equations

$$12x - 15y = 21$$

$$12x + 32y = 68$$

Now subtract the first equation from the second

$$47y = 47$$

$$y = 1$$

Now that we know the value of y we can find the value of x by substituting $y = 1$ in either of the original equations For example

$$4x - 5 = 7$$

$$4x = 12$$

$$x = 3$$

The full solution is $x = 3, y = 1$ With these values both equations are true

Quadratic equations have squares of algebraic quantities as well as the quantities and numbers

Every quadratic has two solutions, though the two may be equal if the quadratic is an exact square

There are several ways of solving quadratics

Sometimes we can factorize the quadratic See FACTORS

$$\text{If } x^2 + x - 12 = 0$$

by factorizing, $(x - 3)(x + 4) = 0$ Therefore either $x - 3$ or $x + 4$ must equal 0, since the product is 0

$$\text{If } x - 3 = 0 \text{ then } x = 3$$

$$\text{or if } x + 4 = 0 \text{ then } x = -4$$

The two solutions are $x = 3$ or -4

Or we can proceed in this way

$$x^2 + 5x - 24 = 0$$

$$x^2 + 5x = 24$$

We add a quantity to make $x^2 + 5x$ a perfect square, this quantity is the square of half the coefficient (5) of x , we add it to both sides

$$x^2 + 5x + \left(\frac{5}{2}\right)^2 = 24 + \frac{25}{4}$$

We now take the square root of each side

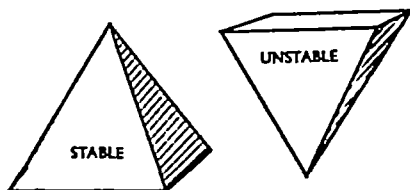
$$x + \frac{5}{2} = \sqrt{\frac{121}{4}} = \frac{\sqrt{121}}{\sqrt{4}} = \pm \frac{11}{2}$$

$$x = -\frac{5}{2} \pm \frac{11}{2} = 3 \text{ or } -8$$

We have to put \pm (+ or -) before the square root because the square root of $\frac{121}{4}$ may be $+\frac{11}{2}$ or $-\frac{11}{2}$

EQUATOR, an imaginary line round the earth, equidistant from both **POLES**, dividing it into the Northern and Southern Hemispheres The regions lying along the equator are extremely hot

EQUILIBRIUM is a state in which a body (such as a pyramid) is at rest under the action of all the forces acting on it This equilibrium is said to be "stable" if the body returns to its position of rest after it has been slightly disturbed, "unstable" if the body is liable to change its position when disturbed



Stable and unstable equilibrium

ERITREA, a former Italian colony lying along the Red Sea
Skins and salt are exported See map of AFRICA

ERMINE. See **STOAT**

EROS is the Greek name for **CUPID**

EROSION is the weathering process by which the earth's surface is continually being worn down by such agents as sun, frost, rain, rivers, sea, wind and ice

ESPERANTO is an international language composed of words formed from roots in the chief European languages and with simple grammar The inventor was Dr Zamenhof (1859-1917)

ESSAY, a piece of prose, fairly short, in which the author gives rein to his own views, fancies and prejudices for our entertainment A volume of essays may cover a great variety of subjects, according to the author's tastes English essayists include Bacon, Addison, Steele, Lamb, Hazlitt, Stevenson, Hilaire Belloc and G. K. Chesterton

ESSAY WRITING, HINTS ON. Know your subject thoroughly If you have to read it up, do so before you start to write

Divide your subject into the various aspects you hope to cover List them, and arrange them in their natural, logical order They will give you topics for your individual paragraphs

Fix the reader's attention with a crisp opening sentence

Let the opening sentence of each paragraph state clearly what your paragraph is about Your next thoughts will expand your opening statement and flow naturally from it until that aspect is covered

Most of your sentences should be simple and short, but avoid monotony by writing a longish sentence every now and then

Choose your words carefully Your aim is to pack the maximum of meaning into every sentence This is achieved by these means

1 Cut out exaggerative words like *very*, *terribly*, *awfully*, *really*, *quite* and *perfect* unless they convey your exact meaning

2 Cut out *all* hackneyed phrases like *thunderous applause*, *bated breath*, *stony silence*, *heart of gold* They have lost their power through too much use Think fresh thoughts and you will find fresh words—your own

3. Don't use too many adjectives and adverbs try to make your nouns and verbs pull more weight *He sprinted* or *he tore along* is better than *he ran very quickly*

4 Think of words that mean roughly the same thing and note the special sense of each For example, *slide*, *slip along*, *slither* *glide*, all mean to move smoothly along, but a ghost or a car or a shadow would glide, a wounded beast would slither, a person undetected would slip along, and a boy on the ice would slide

5 When two words seem equally good for your purpose, choose the shorter

6 When you want to fire the imagination, invent your own simile or metaphor. *At sight of us, they wheeled like a herd of deer and took to the hulls* *The plane hummed its way* See also **IMAGERY**

ESTONIA is a small Baltic state The capital is Tallinn In 1940 it was admitted to the Union of Soviet Socialist Republics The country is well wooded Agriculture and dairy-farming form the chief industries See map of SCANDINAVIA

ETCHING. The word to "etch" comes from a Dutch word meaning to "eat," for an etching is made from lines eaten or bitten into a copper or zinc plate by acid



This shows you what an etching looks like

The plate is first covered with a coating of wax, to protect the parts not to be bitten, and the lines forming the picture are drawn on the wax with a fine needle. Every line drawn exposes a line of copper to the acid, which bites down to the depth required. Once the biting is completed the plate is cleared of all wax. It is then inked all over with etching ink from a tube, and wiped clean again with fine canvas. The lines bitten into the plate, however, retain some ink, and it is from those we get our impression or proof. This is done by placing a piece of damp paper on top of the plate and passing it through steel rollers.

Another form of etching is called "drypoint." It gets this name because no acid is required. The drawing is made direct on the plate with a hard steel needle. It is easy to distinguish a drypoint from an etching which has been bitten, as the former has a much rougher but richer line.

ETHER, a volatile ORGANIC liquid derived from ethyl alcohol. It is used as an ANAESTHETIC.

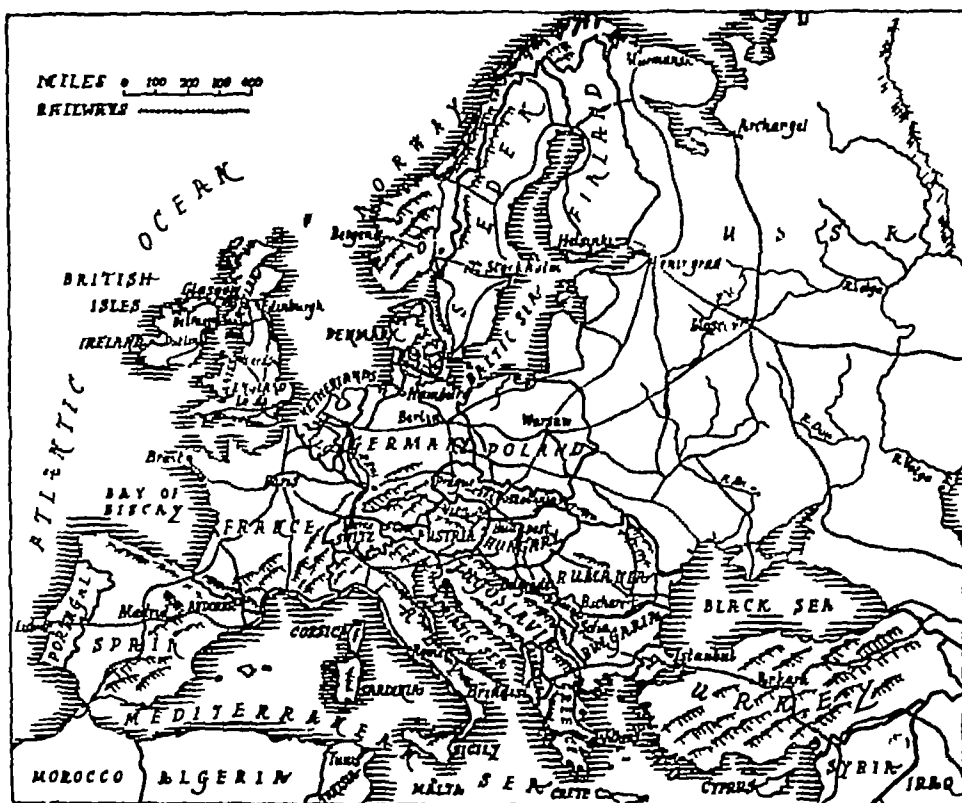
(Quite different is the physical ether, the material which was once supposed to fill all space and in which the vibrations of heat, light and electrical radiations travelled. It is no longer found necessary to

assume the existence of the ether.)

ETHIOPIA is another name for **ABYSSINIA**.

EURIPIDES (about 480-406 B.C.) was a Greek tragedian who is said to have written over eighty plays of which fewer than a quarter survive, among them *Alcestis*, *Electra* and *Medea*. He has less tragic strength and more human tenderness than his predecessor **ÆSCHYLUS** and his rival **SOPHOCLES**.

EUROPE is a continent. It is generally lower in the north than in the south, where are the Carpathian and Balkan mountain ranges, the Alps, which contain the highest peaks, and the Pyrenees. In the north is the mountain ridge of Norway. The Urals in the east roughly separate Europe from Asia. The longest rivers are the Volga and the Danube. Almost all the native inhabitants belong to the white races. Except in the extreme north, the climate is oceanic, tending to continental in the east and greater summer heat in the south. Much of the land has been cleared for cultivation, and the rest is mostly forested mountain. The coastline is indented with numerous peninsulas, islands and partly enclosed seas. Although it is the second smallest continent, Europe is the most densely populated.



Map of Europe, the most densely populated continent in the world

See also AUSTRIA, BALKAN PENINSULA, BALTIC STATES, BELGIUM, BRITISH ISLES, CZECHOSLOVAKIA, FRANCE, GERMANY, HUNGARY, IBERIAN PENINSULA, ITALY, NETHERLANDS, RUMANIA, SCANDINAVIA, SWITZERLAND, UNION OF SOVIET SOCIALIST REPUBLICS

EURYDICE See ORPHEUS

EVAPORATION is the conversion of liquid into gaseous or vapour form, which happens when the liquid is heated until its pressure equals the pressure of the atmosphere. At that point the molecules begin to fly off as gas. See MATTER. The quickest way to evaporate a liquid is to boil it. The heat rays of the sun are quite strong enough to evaporate water little by little. The vapour thus formed blends with the rest of the ATMOSPHERE and when cooled by air currents tends to change back

into water again, i.e. condense, in which case it will fall as rain. See CLOUD. A curious point about evaporation is that while heat is required to vaporize a liquid the TEMPERATURE falls while the vaporizing takes place. Thus if you are overheated and perspire, the heat of your body causes the water to evaporate, making you feel *cooler* as it does so.

EVERGREENS are trees or bushes which keep their leaves for several years instead of shedding them each autumn. Plants cannot afford to lose much water through their leaves in winter and, therefore, evergreens' leaves are small and narrow, like pine and yew leaves, or tough with a very thick cuticle (outer skin) as in holly or laurel.

EVOLUTION means a process of unfolding. The living creatures which first appeared on the earth

were not like modern forms, which have gone through a long and gradual process of change and adaptation. Evidence of this change is shown in many ways. The fossil record in the rocks shows how some modern animals have evolved from earlier forms, and the obvious relationship between animals like lion and tiger, or rat and mouse, suggests a common ancestry. Study of birds, reptiles and frogs within their eggs shows their descent from more primitive fishlike forms. The remains of organs, termed vestiges, which are of no use to their present possessors, are further evidence. These include the tiny wings of ostriches, the hidden hip or leg bones of whales and pythons, and the appendix of man. See also DARWIN.

EXILE. The exile of the Jews to Babylon lasted over fifty years. Nebuchadnezzar carried off captives from Judah in 598 B.C., and in 588 B.C. burnt Jerusalem and destroyed the walls.

EXPERIMENT. Scientists discover the truth about nature in two ways. They may *observe* what happens in nature and endeavour to find out the causes and effects of things. This method is used in sciences like botany, medicine, geology and astronomy. In other sciences, e.g. physics and chemistry, the stage of observation leads to that of *experiment*. We alter the natural course of things to observe the effects. We are asking questions of nature and trying to find out from her answers something we did not know before.

EXPLORATION. From the earliest times all civilizations have felt the urge to explore their surroundings. Thus, before the 14th century B.C. the Egyptians had already travelled south up the Nile and north-east into Assyria, while

the Phoenicians, in search of trade, sailed all over the Mediterranean, down the west coast of Africa and north to Cornwall. Two names of ancient times are outstanding: Pytheas (4th century B.C.) who travelled as far as the Orkneys, and Ptolemy (2nd century A.D.) whose theories of the earth as a globe were proved true by Columbus.

In the north, the first centuries of the Christian era saw the colonization of Iceland, and the discovery of Greenland and the northern parts of the American continent by Eric the Red and his son Leif came in the 10th century.

Most romantic of all medieval travellers was Marco Polo (1254-1324) who, with his father and uncle, left Venice in 1271 on a journey that took them through Persia, Afghanistan, northern Tibet and across a world unknown to Europeans to Peking, returning via the Malay Peninsula and Ceylon after an absence of nearly twenty-six years.

The three great names of the 15th century are Bartholomew Diaz who, in 1488, was the first to sail right round Africa, Vasco da Gama who sailed in 1497 round the Cape of Good Hope, and thence to India, and Christopher Columbus who, in 1492, sailed across the Atlantic to the Bahamas, off the coast of America. Right at the end of the century John and Sebastian Cabot, voyaging in 1497 from Bristol, explored the coasts of Labrador and Newfoundland.

Trade and politics continued to stimulate exploration. In 1519 Ferdinand Magellan started out on perhaps the greatest of all voyages of discovery. From Lisbon he sailed across the Atlantic, right round South America, through the straits named after him, touched at Tierra del Fuego which he thought was



Drake surveys the uncharted seas

part of an Antarctic continent, and thence to the Philippines, where he was killed in 1521, but his crew continued the voyage by way of Borneo and the Cape of Good Hope, thus making the first circumnavigation of the globe. Sir Francis Drake (1540-1596) was to imitate this tremendous exploit during the years 1577-1580, when he sailed round South America and up the Pacific coast of North America in a vain endeavour to find an outlet to the east, after which he returned via the Philippines and the Cape of Good Hope.

In 1534 Jacques Cartier tried to reach China via the Gulf of St. Lawrence and, instead, spent two years founding the French colony of Canada. Then, in 1585, John Davis made an unsuccessful attempt to prove Sir Humphrey Gilbert's theory of a North-West Passage to Cathay. A further attempt at the

North-West Passage by Henry Hudson resulted, in 1610, in the discovery of Hudson Bay, where he was set adrift by his mutinous crew with his son and a few faithful men to die in the open sea.

In 1606 Luiz Vaes de Toires explored the New Hebrides, the Torres Straits, the northern end of Australia and part of the New Guinea coast. Tasman discovered Tasmania and New Zealand, while the ex-buccaneer William Dampier's exploration of the west and north of Australia in 1699 and Captain Cook's voyages from 1767 to 1775 proved Australia and New Zealand to be islands. Cook was killed by natives when visiting Hawaii in the Pacific.

The seas were now charted, so men turned to the land. During the 18th and 19th centuries China was explored by missionaries—they reached Lhasa from China in 1845, Bruce discovered the source of the Blue Nile in 1770, Mungo Park explored the Niger in 1797, Livingstone crossed the Kalahari Desert in 1849 and discovered Lake Nyasa ten years later in his search for the source of the White Nile. This puzzle was eventually solved by the combined discoveries of Sir Richard Burton and John Hanning Speke, who discovered Lake Victoria in 1858, and Sir Samuel Baker who discovered Lake Albert in 1864, working his way down from the Sudan. H. M. Stanley, in his epic journey to find Livingstone (whom he met at Ujiji in 1871), crossed Africa from east to west during the years 1873-1879.

The North Pole was reached by Robert Peary, an American, in 1909 and three years later Captain Scott made his dash for the South Pole, only to find that the Norwegian Amundsen had forestalled him by the bare margin of a month.

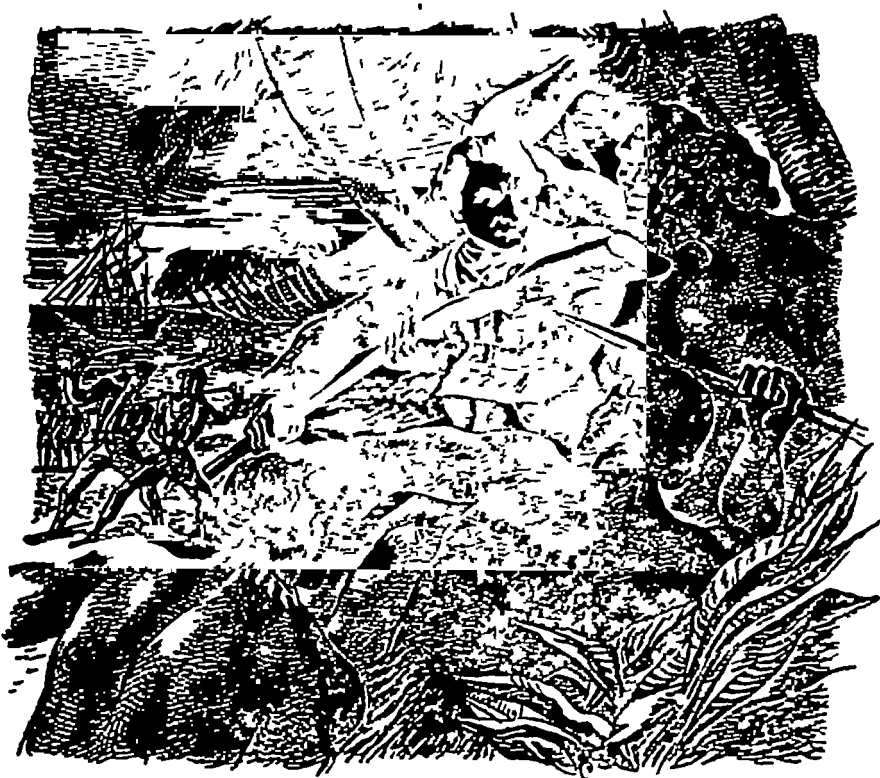
EXPLOSIVES are substances which, when struck or heated, are instantaneously converted into immense volumes of hot gases. These hot gases require much more space than the original substance and exert an enormous pressure around, shifting and shattering their surroundings.

To set off these main charges, detonators are used. These are devices containing chemicals with lead or mercury in them, and so sensitive that the slightest shock will cause them to go off and blow up the main charge, which in its turn will explode with tremendous force. See **GUN**.

EXPORTS AND IMPORTS.

Exports are those goods and services we send abroad, in payment for imports, the goods and services

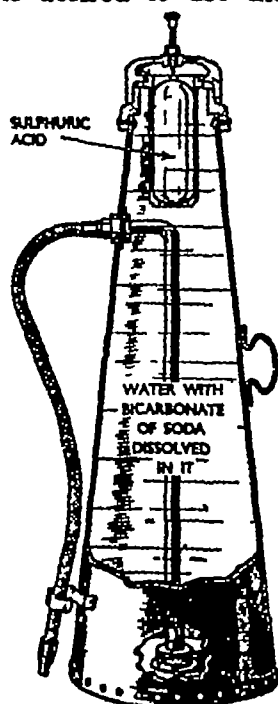
foreign lands send us. In our world different areas and countries have special advantages for the production of distinctive goods or raw materials. Lancashire specializes in cotton articles, Yorkshire in woollen articles. The prairies of Canada have special advantages for the production of wheat, the United States for the production of oil, the East Indies for the production of rubber. These goods are exchanged. When we send cottons or woollens or machines or planes to our customers abroad, we say we export these goods. They are our exports. These very same goods make up the imports into the countries to which they are sent. France sends Britain wines and silks and cosmetics. They are exports from France and also imports into



Death of Captain Cook during his exploration of the Pacific

Britain The greater the exports and imports of the world, the greater is the flow of international TRADE

EXTINGUISHER, FIRE, contains water in which is dissolved washing soda or bicarbonate of soda Inside is also a glass bottle containing sulphuric acid When it is desired to use the extinguisher



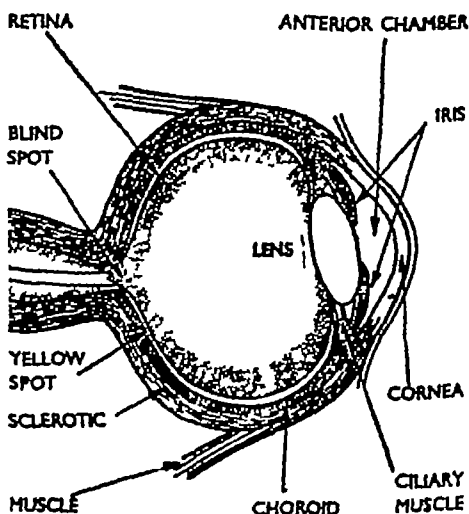
Fire extinguisher

the bottle is broken by means of an external plunger or striker or by inverting the extinguisher The illustrated example shows an extinguisher in which the bottle is broken by an external plunger—the acid combines with the dissolved soda to give off carbon dioxide at high pressure, the gas accumulating at the top of the container and forcing the water down, and up through the central tube, and out with sufficient force for it to be directed on to the fire

EYE, in human beings rests in a bony socket and is moved by seven muscles Fluid from the tear-gland passes across the eyeball, keeping it clean, draining to the nose through a tiny hole at the side of the lower eyelid The eye resembles a CAMERA in principle, the sensitive retina representing the film It is enclosed in a tough, protective layer, the sclerotic, which joins the

transparent cornea in front Within this is the choroid layer which continues in front as the coloured iris The retina, lining the choroid, appears black like the inside of a camera, so that no light is reflected Over it spreads the optic nerve, branching from its point of entrance at the back, causing a blind spot insensitive to light Vision is clearest at the yellow spot The lens is slung by a circular ligament with clear fluid in front of it in the anterior chamber, and clear jelly-like substance behind The iris can be contracted or expanded to enlarge or decrease its central hole, the pupil, according to the intensity of light

When light rays pass through the cornea and pupil they are focused by the lens, which forms an upside-down image of the object the eye is looking at, on the retina The optic nerve carries this impression to the brain, which interprets it the right way up The ligament supporting the lens can be tightened or loosened by the ciliary muscle to allow the lens surface to become less or more convex. This alteration of focus adapts it for viewing both close and distant objects

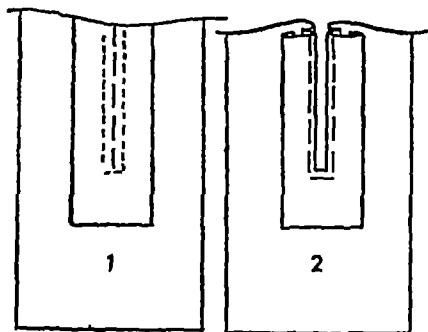


Interior of the eye

FABLE, a short story about animals, having a moral lesson for man **AESOP** and **LA FONTAINE** are the best known fable compilers

FABRE, Jean Henri (1823-1915), was a great French naturalist. Much of his long life in the south of France was spent in watching beetles, ants, grasshoppers, bees, etc., and writing fascinating books about them, of which English translations are published

FACED OPENING, an opening faced with material suitable for use on nightdresses, children's tunics,



How to make a faced opening

and linen bags. It is flat, strong, and decorative. Cut the facing 1 inch longer than the opening and with the selvedge running down the length. Mark the line on the garment where the opening is to be. Tack the centre length of the facing to this line with the right side of the facing to the wrong side of the garment. Run or BACK STITCH $\frac{1}{8}$ inch away from each side of this line (see 1). Cut down the tacked centre line, snipping the material in both corners diagonally as far as the stitching. Turn the facing to the right side and tack down carefully round the opening (see 2). Make

turnings all round keeping the facing even in width, and tack these down. Then finish with a decorative stitch.

FACTORS. The factors of a number are those numbers which divide into it exactly, 2, 3, 4, 6, 9, 12 and 18 are all factors of 36.

Prime numbers have no factors except themselves and unity, 2, 3, 17, 37, 71, are examples of prime numbers. *Prime factors* are factors which cannot be factorized, since they are prime numbers.

To find the prime factors of 630, we divide by 2, then by 3 (the next prime number) and 3 again. No further 3s are possible, so we proceed to 5. (If necessary we proceed to test 7, 11, 13, 17, 19 and other prime numbers.) The prime factors of 630 are 2, 3, 3, 5, 7.

We sometimes want to find the prime factors common to two or more numbers, e.g. 99, 330, 693. We begin by factorizing the numbers

$$99 = 3 \times 3 \times 11$$

$$330 = 2 \times 3 \times 5 \times 11$$

$$693 = 3 \times 3 \times 7 \times 11$$

The only factors common to all three numbers are 3 and 11. The product of these factors ($3 \times 11 = 33$) is the highest number that divides exactly into 99, 330 and 693, and is known, therefore, as the *Greatest Common Measure* (G.C.M.) or *Highest Common Factor* (H.C.F.). To find the G.C.M. of two long numbers which cannot be easily factorized, simply divide the smaller number into the larger, then divide the remainder into the first divisor, any remainder now should be divided into the second divisor, and so on until there is no

remainder The last divisor will be the G C M

Here we are finding the G C M of 45 and 162 by this method

$$\begin{array}{r}
 45 \overline{)162} 3 \\
 \underline{135} \\
 27 \\
 27 \overline{)27} 1 \\
 \underline{27} \\
 0 \\
 9 \overline{)18} 2 \\
 \underline{18} \\
 0
 \end{array}$$

The last divisor, 9, is the G C M of the two numbers

When dealing with more than two large numbers, find the G C M of two of them, then find the G C M of the first G C M and the next number, and so on

To find the G C M of 1,288, 1,736, and 104.

G C M of 104 and 1,288 is 8. G C M of 8 and 1,736 is 8, as 8 divides exactly into 1,736. So G C M of all three numbers is 8

Algebraical Factorizing means finding what quantities multiplied together amount to a given quantity. By multiplying we can show that

$(x + 2)(x - 3) = x^2 - x - 6$
So the factors of $x^2 - x - 6$ are $(x + 2)(x - 3)$

Now look at $x^2 - 7x + 12$, the factors will begin with x , to give x^2 when multiplied $(x \quad)$ $(x \quad)$ The product of the last part of the factors must be a plus number, so they must be either both plus or both minus. When added they must give the minus term in the middle, so they are both minus $(x - \quad)$ $(x - \quad)$

Now we have to find two numbers which add up to -7 and multiply to $+12$. The answer is -3 and -4 , and the factors are $(x - 3)(x - 4)$. Check these factors by multiplying them out.

Look also at $x^2 - 3x - 10$. Examining the factors of -10 , we

find that $(-5) \times (+2) = -10$, and $-5 + 2 = -3$. So the factors are $(x - 5)(x + 2)$. Check by multiplying the factors out.

The following standard forms are worth remembering

$$(x + y)^2 = x^2 + 2xy + y^2$$

$$(x - y)^2 = x^2 - 2xy + y^2$$

$$x^2 - y^2 = (x + y)(x - y)$$

$$x^2 + y^2 = (x + y)(x^2 - xy + y^2)$$

$$x^2 - y^2 = (x - y)(x^2 + xy + y^2)$$

We can factorize many expressions by comparison with these forms

Thus $8a^3 - 27b^3$ is the difference of two cubes, instead of x^3 we have $(2a)^3$, and for y^3 we have $(3b)^3$. Therefore $8a^3 - 27b^3 =$

$$(2a - 3b)((2a)^2 + (2a \times 3b) + (3b)^2) = (2a - 3b)(4a^2 + 6ab + 9b^2)$$

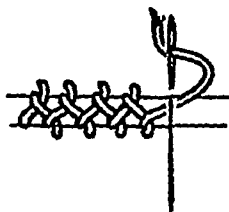
If there is a common factor in all the terms of an expression we can "take it out," or write it outside brackets. Thus in $3a^4b - 12a^3b^2$, the common factor is $3a^3b$. So

$3a^4b - 12a^3b^2 = 3a^3b(a - 4b)$
Now $(a^2 - 4b^2)$ is the difference of two squares, so the factors are

$$3a^3b(a + 2b)(a - 2b)$$

FAGGOTING is an attractive method of joining two neat edges

First tack the edges securely to a piece of strong paper, keeping them exactly the same distance apart all the way. Then work the faggoting stitch as shown.



Faggoting

FALKLAND ISLANDS, a group of British islands off the extreme tip of South America.

FARADAY, Michael (1791-1867), foremost among English scientists in the field of electricity and magnetism and notable for his work on electrical transformers. His chemical investigations also led to important discoveries.



Faraday in his laboratory

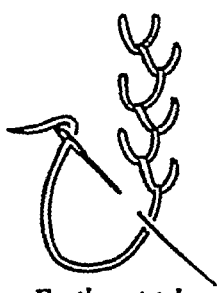
FASCISM is the name of the movement started in Italy by Mussolini. The word is derived from the Latin *fascis*, the bundle of rods enclosing an axe carried in ancient Rome before the chief magistrate as a symbol of his authority. After the First World War ITALY suffered from unemployment and other hardships, and the government, which was a parliamentary one, seemed unable to cope with the situation. Fascist societies sprang up in various cities. Their object, they said, was to bring order and efficiency to Italy. They adopted black shirts as their distinguishing uniform and conducted a kind of guerrilla warfare against working-

class opponents. In 1922 they marched on Rome and seized power without opposition from the king. Victor Emmanuel Mussolini became prime minister, or *dice* (leader) as he was called. From then on the normal democratic liberties were abolished and the fascist doctrine propagated. "Nothing without the State, nothing against the State, nothing beyond the State." See **TOTALITARIAN STATE**.

FATS and OILS Chemically these materials are compounds of glycerine with certain types of **ORGANIC acid**. They are produced in animals and plants as a store of food and energy. None of them is soluble in water, but they will all combine with caustic alkalis to form **SOAPS**. Such fats as whale oil, herring oil, lard, tallow, bone fat and butter are of animal origin. Linseed, sunflower, soya, cotton seed, peanut, castor, olive, palm and coco-nut oil are of vegetable origin. They are used raw as food-stuffs, liniments and lubricants, and are manufactured into **PAINT, soaps, CANDLES and EXPLOSIVES**, etc.

FAUNS, in **CLASSICAL MYTHOLOGY**, are gods and goddesses who dwelt in the woods and protected shepherds and flocks. The chief was Faunus, the same as the Greek god Pan who is represented with horns and goat's legs and feet.

FEATHER STITCH is a popular stitch used for the decoration of



Feather stitch

children's garments and underclothes and is worked as follows. The thread is held down with the left thumb, a slanting stitch is picked up on the left side

of the thread with the needle at an angle and pulled through over the working thread

A similar stitch is made on the opposite side and continued left and right

FEDERAL GOVERNMENT, the central government of a group of states which have formed a union, each retaining self-government in internal affairs U S A is such a federation of states See also CONSTITUTION

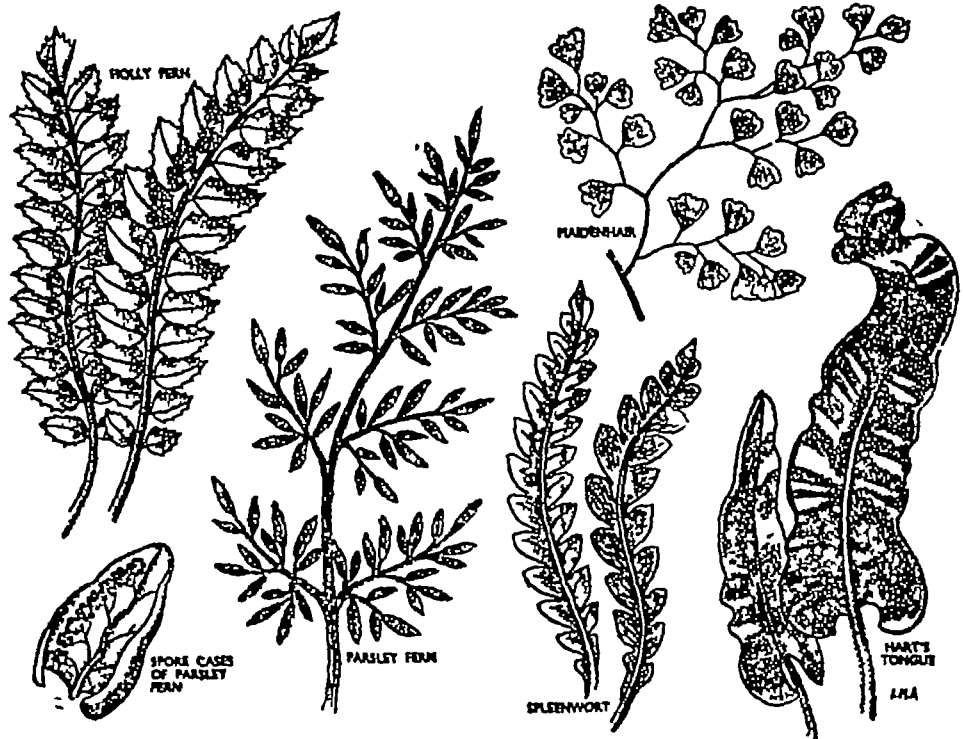
FEDERATION. See FEDERAL GOVERNMENT

FERNS are a group of plants which grow roots and leaves (the fronds) but no flowers They reproduce by spores, which look like fine brown dust, and are formed in spore-cases on the undersides of some fronds The spores form tiny heart-shaped plants about the size of a thumbnail, these little plants produce eggs and sperm which

unite together to form the large familiar fern plants Ferns evolved millions of years before there were flowering plants and tree ferns grew 60 feet high Fern leaves grow from an underground creeping stem known as the RHIZOME Some ferns require to live in woodland, others in damp, rocky places, while bracken spreads rapidly in open moorland Some British types are hart's tongue, spleenwort, maidenhair, parsley, royal, holly and shield ferns.

FERRET. See FLESH-EATING MAMMALS

FERTILIZATION is the process, in both plants and animals, in which the male reproductive CELL unites with the female cell, so that an EMBRYO can develop In lowly plants, e g seaweeds, the reproductive cells are often free-swimming and unite in water In flowering plants pollen grains (the



Some common ferns to be seen about the British countryside

male cells) are carried to the stigmas of the ovary during pollination and work their way to the female cells in the ovule. In lower animals fertilization often occurs in water. In higher forms of life mating takes place when the male cells (sperm) are passed directly into the female's body. Fertilization of the egg cells is internal. It occurs in insects, reptiles, birds and mammals. See also FLOWER and POLLINATION.

FERTILIZER. All plants, during their growth, draw food from the soil. This food consists of certain minerals taken in by the plant roots in the form of moisture. Unfertile soils which lack plant foods, or which have grown many crops, must have their deficiencies made up by the addition of powder fertilizers or MANURING fertilizers break down more quickly into the liquid which plants are able to imbibe. They are made by mixing certain chemicals together in the proportions known to suit particular types of plants.

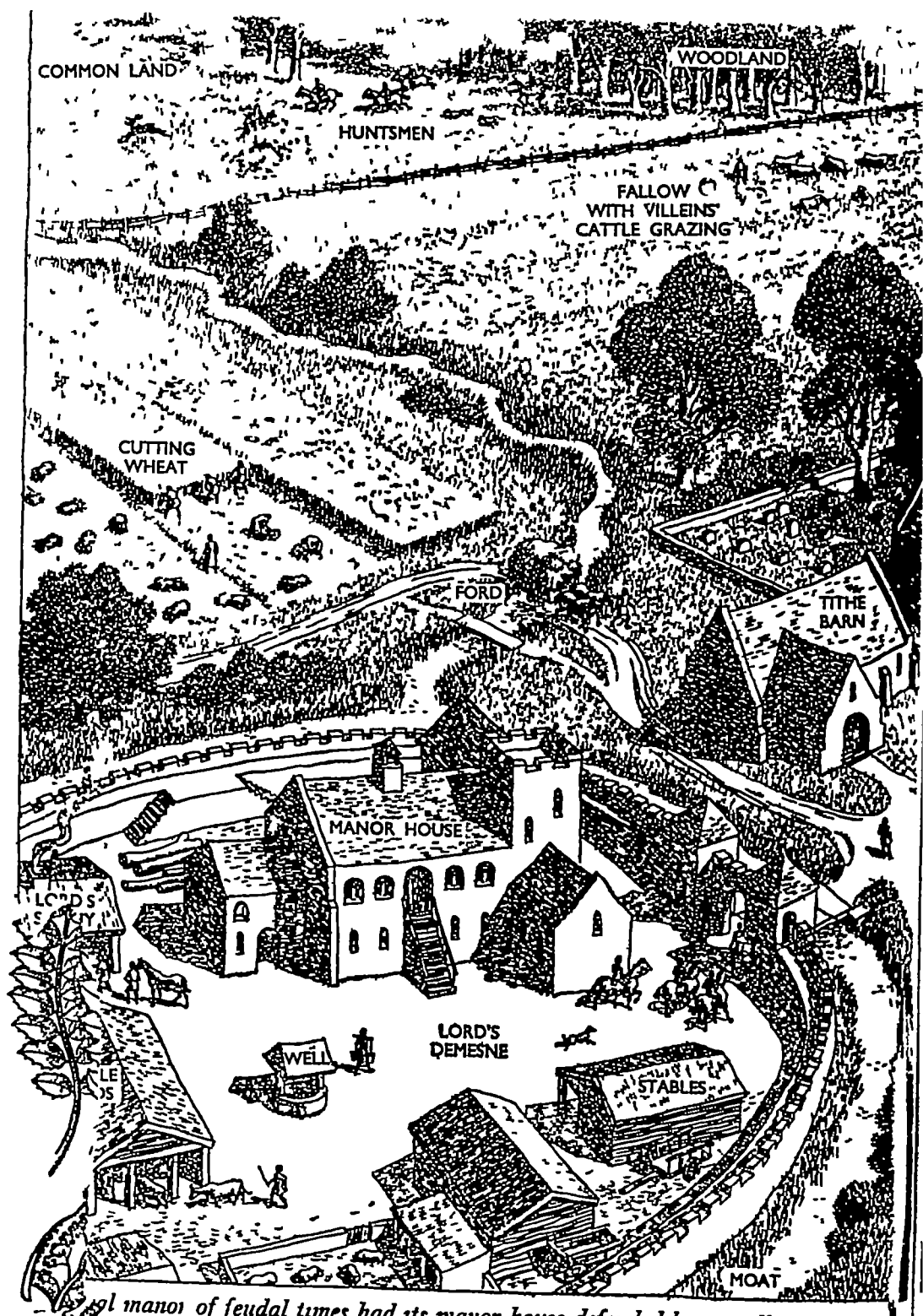
FEUDAL SYSTEM, grew up in western Europe from about the 10th century and continued in France and Russia and the Balkan lands till recent times. It was developed in England in a somewhat modified form by William the Conqueror.

Under the Feudal System (*feud* = *fief* = *estate*) all the land in the country belonged to the king, who granted estates to his barons. These estates, known as fiefs, were given on condition that the barons holding lands rendered certain services to the king, generally military service. The barons were called tenants-in-chief, and let some of their lands to sub-tenants, who helped the baron in making up the number of knights and men-at-arms which was demanded by the king.

Any person who received land, whether he was a tenant-in-chief or a sub-tenant, came to the king or baron who gave it, and knelt before him and became his "man"—did homage (*homo* = *man*). He placed his clasped hands into the hands of his overlord, and said "I swear to be faithful to you as a man to his lord", then the overlord gave the tenant a flag, a staff, or a piece of turf as a sign that he had granted him the land.

The tenant kept part of the land, the *demesne* (from *dominus* = *lord*), for his own use. He let the rest in strips to men who would till the strips and, instead of paying rent for their land and hut, work a certain number of days a week on the lord's *demesne*, which included not only the enclosed *demesne* where stood the manor house, but also the strips of land which the lord had kept for himself. Most of these men were known as "villeins" (from *villa* = *farm*), and could not leave the estate on which they were born. See the illustration on pp 222-223. Besides the military fiefs, lands were granted to monasteries in return for religious services, such as the saying of masses for the souls of the departed.

In England the plan is somewhat described as the Manorial System. William the Conqueror gave lands or manors to those who helped him win his kingdom, but he gave each man a number of small strips scattered over the country, which made it difficult for a disloyal baron to raise an army against the king. William also made the tenants—tenants-in-chief and sub-tenants—swear allegiance directly, as well as to any overlord. The BLACK DEATH hastened the break-up of the Feudal System, and by Elizabeth's time the "villeins" had become free. See p 221.



A typical manor of feudal times had its manor house defended by a wall and the land divided into three fields, which took turns at growing crops. Some land lying fallow. One-tenth of all produce went to the Church,



to be stored in the great tithe barn. The villeins' cattle grazed on the fallow and common land while pigs fed in the woods. Hunting and hawking were favorite pastimes of members of the lord's household. See p. 221.

FICTION is prose narrative in which characters and events are invented by the author and described so as to give an impression of reality. A long, continuous narrative with a number of characters and events is called a *novel*. See **DEFOE**. A *short story*—because it is short—usually concentrates on a single incident and a small number of characters.

FIFE, a small instrument of the LUTE family, mainly used in drum and fife bands. See picture on p. 405.

FIGURE OF SPEECH. See **IMAGERY**.

FINANCE is the provision of CAPITAL for a business. Financing has itself become a business, the largest of such businesses are of course **BANKS**. Banks finance business, they finance industry.

In Britain the minister who looks after national money matters is the **CHANCELLOR OF THE EXCHEQUER**. In other countries he would be called the Minister of Finance, or have a similar title.

The finances of a company sometimes have a more restricted mean-

ing, and apply to its assets. When a business is efficiently run, with ample funds behind it, it is financially sound.

FINCH, a small blunt-beaked BIRD, a seed and grain eater. Finches form mixed flocks in winter. Common British residents are the chaffinch, greenfinch, goldfinch and bullfinch. See **CAGE BIRDS** and p. 76.

FINGERPRINTS are impressions left by the pads at the ends of the fingers. They form shapes, such as loops, arches, whorls and composites, and by means of these characteristics it is possible for them to be classified. The classified fingerprints of known criminals are kept at a central point in charge of experts, when fingerprints found at the scene of a crime are submitted they can be tracked in the files and the criminal who made them identified.

FINLAND consists of a low plateau of ancient rocks studded with lakes and densely forested. Hardy crops are grown in forest clearings in the south, but timber, wood pulp, paper and butter are the chief exports. The capital is



Comparing an enlarged fingerprint with those of known criminals

Helsinki Lapps inhabit the barren tundra region in the north, which stretches into Sweden and Norway and is known as Lapland See map of SCANDINAVIA, which Finland adjoins

FIORD, a narrow, branching inlet of the sea, frequent in Norway, with precipitous sides, formed where the lower parts of valleys made by GLACIERS have been submerged See ICE AGE

FIRE is a vigorous chemical combination in which heat is given off and light and flame produced In household fires the material burned is usually CARBON, it combines with the OXYGEN of the air See also OXIDES

FIRE-DAMP is an explosive gas formed by air mixing with gas given off by the coal in mines See DAVY LAMP and METHANE

FIRM, another name for a business unit, whether it is a one-man business or a PARTNERSHIP or a COMPANY. It may be a business to grow, mine, manufacture, or distribute, either WHOLESALE or RETAIL The firm will try to satisfy the needs of the public and make a profit for itself

FIRST AID is help given to an injured person before a doctor can be fetched Its aim is to prevent injuries from becoming worse, but a person giving first aid does not go beyond this and try to do a doctor's work If the injury is serious, the person must not be moved, but help should be sent for immediately.

For advanced first aid, knowledge is needed of the position of the bones and blood vessels, of types of unconsciousness, poisons, artificial respiration, treatment of fractures, etc Treatment of slight burns, scalds, cuts and sprains, and of faints can be more easily learnt *Burns* are caused by dry, and *scalds*

by damp, heat Their treatment is alike The wound must be quickly protected from the air, either by being covered with clean cotton-wool, or—better—by putting into warm water to which bicarbonate of soda (1 dessertspoonful to 1 pint of water) has been added A dressing can then be made from strips of clean lint soaked in the solution, covered with cotton-wool, and bandaged lightly Treatment for shock should be given (see below) *Cuts* and *grazes* must be cleaned and made sterile, so that they can heal quickly unhindered by germs The hands of the first aider, the dressing and the wound can be sterilized by a mild antiseptic, and the dressing (e.g. boracic lint) held in place by a bandage *Sprains* result from sudden wrenches of muscles and tendons First aid treatment attempts to limit the swelling by providing cold, pressure and rest The limb should be placed comfortably, the joint bandaged firmly, and the bandage soaked in cold water *Fainting* or *faintness* often occurs in hot atmospheres or from shock A patient feeling faint should lie down, or sit with head between knees, in fresh air, and be given water to drink If consciousness is lost, the patient should be laid with the head lower than the feet, with the clothing loosened Water may be splashed on the face and smelling salts applied to the nose *Shock* often accompanies injuries, and it is important to treat this Fresh air and warmth are needed, so the patient should be covered with rugs, given hot, sweet tea, coffee or milk if conscious and able to swallow, and hot water bottles Loosen tight clothing

Bandages may be used to hold dressings in place or support limbs

FIRST WORLD WAR. See WORLD WAR (FIRST).

FISH are the lowest class of **VERTEBRATE** (backboned) animals, and live in fresh or salt water. Fish breathe oxygen dissolved in water by means of their **GILLS**, passing water through the mouth and out under the gill covers. They swim by sideways movements of the tail, guiding and balancing themselves with the fins. The fins are formed of bony rays covered by skin. There are paired pectoral and pelvic fins which represent fore and hind limbs respectively, and unpaired above and below and on the tail, which can be lowered flush with the body. Overlapping scales cover the body, minute in plaice or **ERLS**, large in carp. Fish have no eyelids, use their nostrils for smelling but not breathing, and often taste by means of small appendages near the mouth, as in loach. The ear has no outside part. Fish teeth are outgrowths from the jawbones, and may be reinforced by teeth on the tongue and the sides and roof of the mouth. Some fish prey on smaller fish, some browse on seaweeds, and others, such as the herring and mackerel, sieve minute animals from the water with comb-like strainers on their gill-bars. Sea fish, like cod, may lay many thousands of free-floating eggs, but few survive to grow up. Salmon and sea trout swim up rivers from the sea to lay eggs.

Fish as food. Buy fish in season as much as possible, for it is then at its best, cheapest and most plentiful. Oily and freshwater fish should be cooked as soon as possible after buying. *Signs of freshness* bright, prominent eyes; red gills, bright scales, firm flesh with no bluish tinge, a fresh odour. *Signs of staleness* sunken eyes, brown or yellow gills, limp, soft flesh, any unpleasant smell. Thick slices from a smaller fish cook better than thin

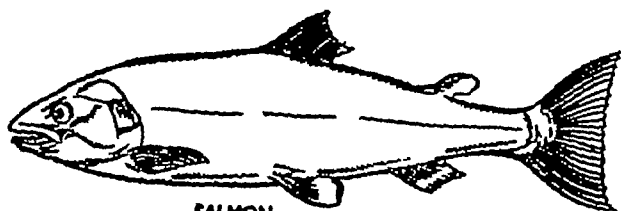
steaks from a larger one. Well-cooked fish is very light and easily digested, but if underdone it is neither palatable nor wholesome.

The chief methods of cooking are boiling, frying, grilling, steaming, and baking. (1) *Boiling* is suitable for a large, whole fish or a thick slice, e.g. cod, hake, salmon, turbot, halibut and whiting. One tablespoonful of vinegar is added to the water in which fish is to be boiled, this makes the flesh firm, white, and tender. Salt fish is put into cold water, salmon in boiling water without the addition of vinegar, and all others into hot water. Once the water comes to the boil it should be allowed to simmer and not boil violently, this prevents the fish from breaking. The time for cooking is eight minutes to the pound, or longer if the fish is thick—note when it comes away from the bone if tested with a fork. (2) *Frying* is used for small whole fish like sole, haddock, whiting, and for steaks of halibut, cod, hake, and skate, and for fillets of plaice and sole. Trout should be grilled (whole—never cut this fish down the centre), and this method is good for herring. After washing the fish should be carefully dried with a cloth, otherwise it will break during the frying. (3) *Steaming* is preferable to boiling and the best way of cooking fish for invalids. It may be done in a steamer or, if small, between two plates over a pan of boiling water. (4) *Baking* is a good method for fish like haddock, cod, hake, halibut, and whiting which can be stuffed. Fish may be served with various sauces.

FISHBONE STITCH, used to hold two edges of a slit together. Fasten the thread to one of the edges, bring the needle out through the slit, then take a diagonal stitch into the other side, bringing the



PILCHARD



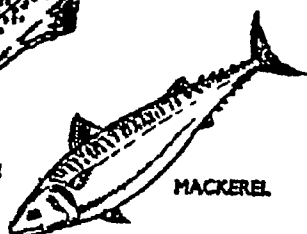
SALMON



COD



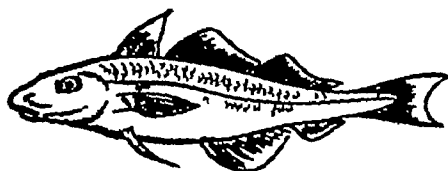
DOG FISH



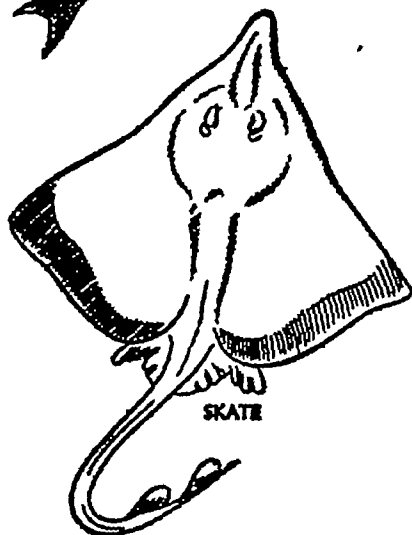
MACKEREL



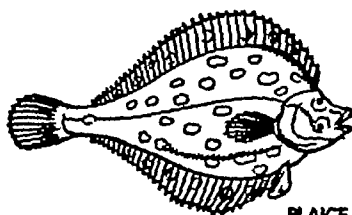
HERRING



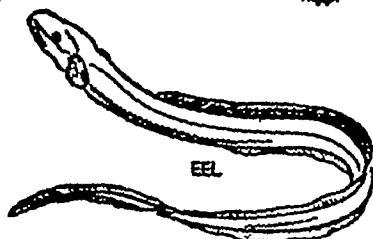
HADDOCK



SKATE



PLAICE



EEL

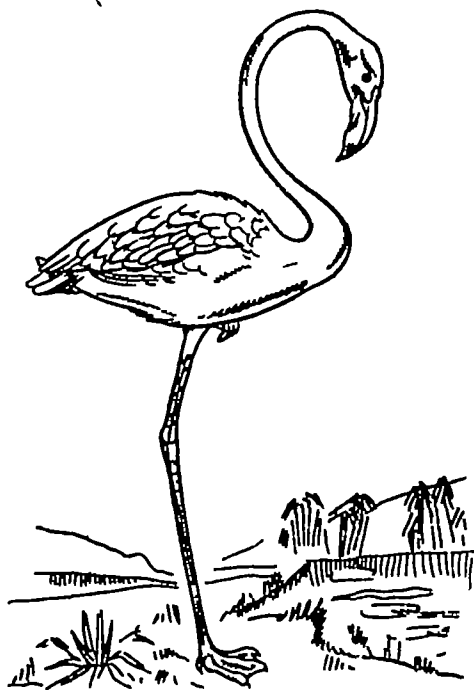
Fish breathe through gills and swim by moving their tails

needle back through the slit, towards yourself Repeat on the first side of the slit and continue, alternating from one side to the other See a diagram of this stitch under
DARNING

FISHING, as a sport, can be divided into two classes—fly fishing and coarse fishing In fly fishing the fish caught are trout and salmon, found in rivers in Scotland, Devon and Cornwall The bait is an imitation fly made of feathers attached to a small steel hook at the end of the line The angler in long waders casts his line so that the fly falls lightly on the water and is carried downstream by the current He repeats this until a fish rises to his fly and is hooked To pull straight-away would be to lose fish and line as well, as the strong fish rushes up and down stream and even leaps to free itself The angler keeps a regular pressure on the line to tire the fish out and eventually draws it to the bank

In coarse fishing the fish caught include roach, perch, bream, tench and eels, found in almost any river or stream A line is baited with worms, gentles, or bread paste, and suspended from a float When a fish bites, the float bobs, and with a dexterous pull of the line the fisherman lands his catch Eels are apt to swallow so much of the hook and line that their heads have to be cut off to free the hook

FIVES, a ball game for two or four persons, played in a court walled on three or all four sides, where the ball is hit with either hand against the wall There are three variations of the game, Eton fives, Winchester fives, Rugby fives, in Eton fives buttresses and other hazards are included in the walls in imitation of the school courts where the game was originally played by the boys.



Flamingo, a semi-tropical bird

FLAGS. A flag is a piece of bunting made up of various colours and shapes and run up on a flag-staff so that it waves in the wind The most important British flags are the Royal Standard, the UNION JACK, the White Ensign, the Blue Ensign and the Red Ensign The *Royal Standard* bears the arms of England quartered with those of Scotland and Ireland The *Union Jack* is the national flag on it are shown the crosses of St George, the patron saint of England, St. Andrew, the national saint of Scotland, and St Patrick, the national saint of Ireland Each of the three crosses is distinct This flag is flown by representatives of the Empire all over the world and from the flagstaff of any man-of-war in the Navy. The *White Ensign* is the flag of the Royal Navy It is flown only on a naval vessel, with the exception that by a grant given by William IV in 1829, vessels belonging to the Royal Yacht Squadron are

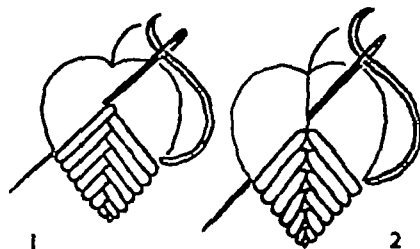
allowed to fly it. It is a serious offence for a vessel of any other kind to fly the White Ensign, and an officer of one of H M ships may board such a vessel, take the colours, and report the ship to the authorities for disciplinary action to be taken against the owners and captain. The *Blue Ensign* is the flag of the public services other than the Royal Navy, and is also the flag of the Royal Naval Reserve. Certain vessels of the British mercantile marine also fly this Blue Ensign if the captain and a given percentage of his officers belong to the Royal Naval Reserve. The *Red Ensign*, or "Red Duster," as it is popularly called, is the flag of the British Merchant Service since Queen Anne in 1707 ordered that merchant vessels should fly it.

FLAME is a mass of gas or of very small solid particles so hot that it gives out light.

FLAMINGO, a semi-tropical wading BIRD with pink, black and white plumage, and a curved, strainer type of bill. Enormous flocks live together, building mud mounds in shallow water.

FLASH POINT OF OILS, the temperature at which the vapour of volatile fuels, such as paraffin, will explode when mixed with air and exposed to a small flame. This is a very important factor in judging the safety of an oil.

FLAT STITCH is a useful embroidery stitch for filling leaves

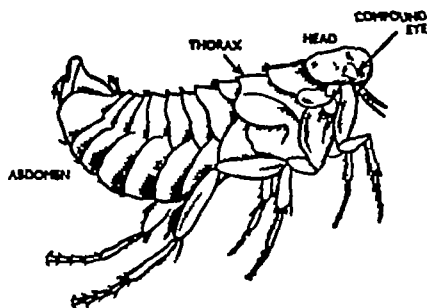


Two varieties of flat stitch

and flower petals. (1) shows the method of working, note that each stitch crosses over the bottom of the last. (2) shows a variation of this stitch but without any overlapping.

FLAUBERT, Gustave (1821-1880), was a French novelist, author of *Madame Bovary*, a study of provincial life, which is the outstanding example of REALISM in fiction.

FLEA, an order of wingless INSECT, a few species of which attack man. Other fleas are adapted to live on, and suck blood from,



Parts of the flea

cats, dogs, fowls, or squirrels, etc. The larvae are minute and worm-like.

See PARASITE.

FLESH-EATING MAMMALS (Carnivores) are MAMMALS which include the CAT, DOG, and SEAL families, besides the varieties of kinkajou, HYENA, skunk, BADGER, OTTER, mongoose, ferret, racoon, STOAT, WEASEL, and many others. (The allied BEAR and PANDA are vegetarian.) Most hunt other animals for food, and possess large canine teeth for tearing their prey. Many, such as mink and sable, are valued for their fur. The kinkajou is cat-like, with a long prehensile tail, up which it can climb. It makes an excellent pet. American skunks have black and white fur, and give out a repulsive smell as defence.

The several kinds of mongoose of India and Africa are great fighters for their small size, and expert snake-killers. Ferrets, closely related to stoats, are kept for rabbiting in Britain. The American racoons, different types of which catch frogs, or crabs, etc. have striped faces and ringed tails, and wash their food before starting to eat. Pine martens and polecats used to live freely in Britain, but are now becoming extinct.

FLIGHT, PIONEERS OF.

When the rate at which modern aircraft travel is considered, the distance they can cover, and the loads they can carry, it seems incredible that the first power-driven aeroplane was built by Wilbur and Orville WRIGHT so comparatively recently as 1903, and that their great achievement then was to remain in the air for 59 seconds.

Wilbur and Orville Wright so greatly improved upon their original machine that in 1905 they set up a new record by covering a distance of 24 miles in a circular course in 38 minutes. Then in 1908 they set up another record when they produced a machine which remained in the air for 1 hour 15 minutes.

The first cross-country flight was made in the same year by the French inventor, Farman, who covered approximately 17 miles in 15 minutes, while a great advance was made the following year when the first crossing of the English Channel in a power-driven machine was made by Blériot.

Sir A. Whitten Brown and Sir John Alcock embarked upon an undertaking demanding great courage, when in 1919 they set out to make a first crossing of the Atlantic in an aeroplane. Their enterprise was successful and during their journey they maintained an average speed of 118 miles an hour. In 1919,

too, Sir Ross Smith and Sir Keith Smith made the first flight to Australia.

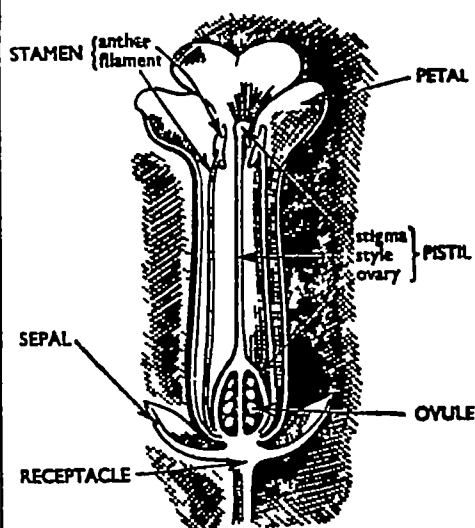
As a consequence of the progress that had been made in flying, an air service between Britain and the Continent began in 1919, and in 1924 Imperial Airways was founded.

FLORA is the Roman goddess of flowers in CLASSICAL MYTHOLOGY.

The word also means all the plants of a particular region.

FLOWER. The flowers of plants are the reproductive parts. They produce both male cells contained in pollen grains, and female cells contained in ovules, in the same flower, as in the tulip, buttercup, etc., or in separate flowers, as in the willow and hazel.

A typical flower has its parts arranged in tightly packed spirals or circles, growing around the end of the flower stalk. The shape of a flower fits the particular way it is pollinated. The calyx around it is made of sepals which protect the bud before it opens. The corolla of petals attracts insects. Calyx and corolla together, when indistinguishable from each other, are known as the perianth. Each sta-



Parts of a flower

men's stalk or filament bears an anther, within which grow pollen grains, freed, when ripe, by the outside of the anther splitting. The pistil is formed of the stigma, often feathery or sticky to catch pollen, joined by the tubular style to the ovary. Within this grow one or many ovules arranged in various ways. The receptacle is the base of the flower.

The number of sepals, petals, stamens and pistils in a flower varies widely from one species of flower to another and one flower head may be made up of a group of many florets, as in the daisy family. See

FRUIT, POLLINATION, WILD FLOWERS, FLOWER GARDEN. Flowers more than repay the time and trouble spent on them by the pleasure their colour and beauty give, and the gardener can, with a little forethought, have a supply of flowers in his garden from April onwards throughout the summer and autumn. **PERENNIALS** give the least trouble, for once planted they will continue to produce flowers for many years. Lupins, pyrethrums, phlox, Michaelmas daisies, delphiniums and chrysanthemums are useful perennials. **ANNUALS** and **BIENNIALS** may be reared in the **GREENHOUSE** and planted out later, or they can be sown directly into their appointed place when the weather is suitable. Cornflowers, stocks, asters, clarkia, calendula, salvia, Canterbury bells and wall-flowers all make a good show. See **HERBACEOUS BORDER, PROPAGATION, and THINNING OUT.**

FLUORESCENCE. When light of a certain wavelength falls upon certain substances they glow with a light and colour of their own.



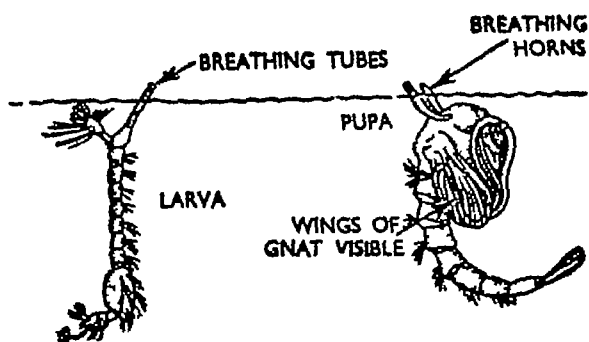
At work in the flower garden

Fluorescent glass is used in gas discharge lighting tubes. See **LAMP.**

FLUTE, a name now restricted to those instruments in the woodwind class in which the sound is made by the player blowing across the column of air, and thus setting it in motion. The instrument consists of a cylindrical tube, closed at one end, with a mouth-hole across which the player blows, and keys covering holes in the tube by means of which the length of the column of air is altered, producing differences in pitch. See **FIFE** and **PICCOLO** and picture on p. 404.

FLUX (soldering) is a material such as resin or killed spirits (zinc chloride) used in soldering to fuse the solder and metals being joined.

FLY, a member of an **INSECT** order which strictly includes only those with one pair of functional wings, though another pair may persist as vestiges. The larvae are legless grubs or maggots, forming pupae from which emerge the full-grown insects. See **METAMORPHOSIS.** Gnats, mosquitoes and midges have long antennae. The females of the

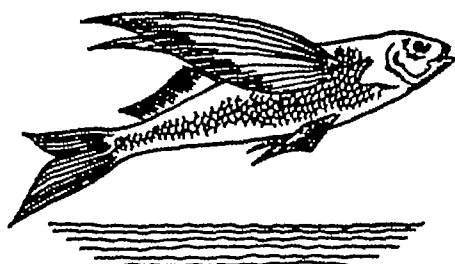


GNAT EMERGING

Larva of the gnat changing to the full-grown insect

blood-sucking types have mouth-parts adapted for piercing and sucking. Certain species of mosquitoes carry malaria or yellow fever among men from a diseased person to a healthy one. Daddy-long-legs larvae are the leather-jackets destructive to grass roots. Flies with short antennae include hover-flies, house-flies, blow-flies (bluebottles) and bot-flies, with hundreds of species, many of which do harm to plants, animals or man. House-flies are dangerous because of their habits of passing direct from dirt to human food, infecting the food with germs from their feet, excretions or saliva.

FLYING FISH are tropical and semi-tropical fish the size of a herring, with wing-like pectoral fins.



Flying fish leaping into the air

They leap from the sea, remaining in the air some seconds before falling back. They cannot really fly but glide along, their wings cannot be used as fins in the water.

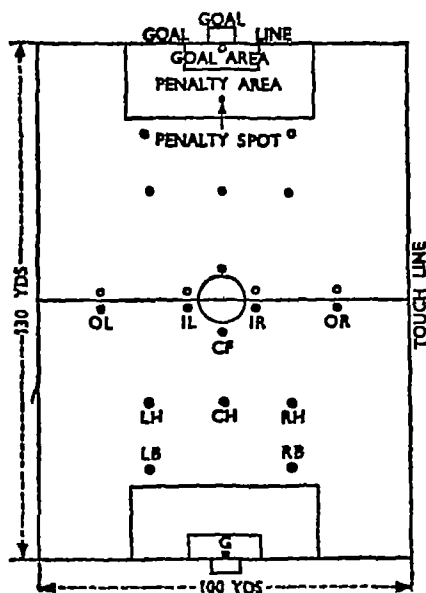
FLY STITCH. See **V OR Y STITCH**.
FOLK-DANCING. See **DANCING**.
FOLK-LORE is made up of the traditions and legends of the common people in every country—the stories which people invented and handed down verbally long before there were books to read. Such are the tales of fairies, goblins, sprites which most European countries share.

During the Middle Ages real people or ancient heroes became figures of folk-lore, most famous being Robin Hood, the "good" outlaw, who lived in Sherwood Forest with his followers and Maid Marian, robbing the rich for the relief of the poor. See also **Ballad** under **ENGLISH LITERATURE**, and **MYTHOLOGY**.

FOLK-SONGS. All countries have their own folk-songs—songs of the people of unknown authorship handed down by word of mouth. Many of these, like sea shanties, rowing songs, or weaving lilt, have been work-songs, designed to help people to keep together while doing some rhythmic job, others are love songs, some are descriptive of some locality, while others may tell a story.

FOOTBALL. *Association* football is played between two teams of eleven players each on a field 100-130 yards long by 50-100 yards

wide. The object of the game is to score goals by kicking a blown-up leather ball into the opponents' goal, which is 24 feet across by 8 feet high. Each team has a goalkeeper to guard the goal, supported by a left and a right back, in front of them are the left, centre and right half-backs, and for attack there are five forwards—outside left, inside left, centre forward, inside right, and outside right. To begin the game and after a goal the teams line up with both sets of forwards



Association football pitch

facing each other along the halfway line, and when the ball has been put into play each team endeavours to get the ball and pass it among its members towards the opponents' goal. No player, except the goalkeeper, may handle the ball, but heading is allowed. Tripping is illegal, but players may charge each other shoulder to shoulder. When a player in the opponents' half of the field receives a forward pass from a colleague, he must have at least two members of the opposing

side between himself and the opponents' goal, otherwise he is "off-side," and a free kick is awarded against his side. If a defending player sends the ball across his own goal-line, the attacking side is awarded a corner kick from the nearest corner flag, the player taking the corner kick sending the ball to the players clustered in the goal mouth. If an attacking player sends the ball across his opponents' goal-line, the goalkeeper or another player of the defending side kicks the ball into play again. If a player sends the ball out of play over the touch-line, then a member of the opposing side throws it from over his head into play again. The game is controlled by a referee who stops the game by blowing a whistle for any infringement of the rules, awarding a free kick against the guilty side, or a direct shot at goal from the penalty spot if the foul is committed by a defending player inside his own penalty area. The referee is assisted by a linesman on each touch-line, who decides when the ball has left the field of play. The game consists of two periods of 45 minutes each, the teams changing ends at half-time. In important matches where a definite decision has to be reached, extra time is played if neither side is leading at the end of 90 minutes' play.

Rugby football is a game played between two teams of fifteen players each on a field not exceeding 110 yards by 75 yards. Each team has one full-back, four three-quarter backs, two half-backs, and eight forwards known as the pack. The oval-shaped leather ball can be kicked and handled, but every player of the side with the ball at any particular moment must keep behind the ball or he is offside; thus all hand-to-hand passing has

to be done backwards. The object of the game is to score as many points as possible. Points are obtained as follows. If a player crosses the opponents' goal-line and places the ball on the ground it is called a try and counts as three points, and it entitles his side to a kick at goal, which is a cross-bar 18 feet 6 inches long slung 10 feet high between two long upright posts, and the idea is to kick the ball over the bar and between the posts. The kick is taken from any point in a line at right angles to the point on the goal-line where the try was obtained. If the kick is successful two more points are gained. A drop goal counting as four points is scored when a player drops the ball and kicks it as it begins to rise from the ground over the bar during the course of the game. Penalties are awarded against players infringing the rules, a free kick awarded in this way may result in a penalty goal, which counts as three points. For minor infringe-

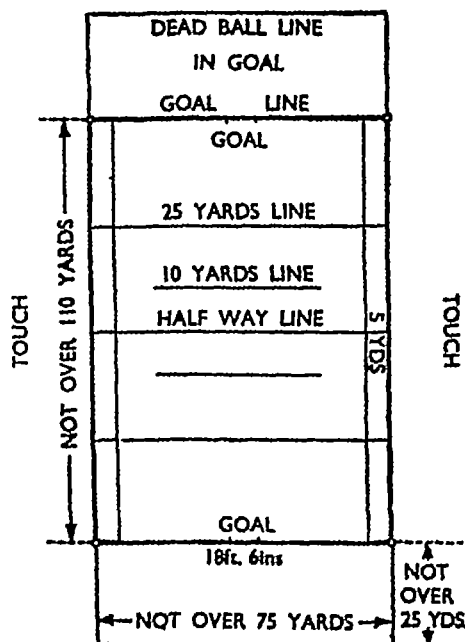
ments a scrum composed of all sixteen forwards is formed, their arms round each others' shoulders, the scrum-half puts the ball in the centre of the scrum, and the forwards try to push and heel the ball out again to him for him to pass to his other half-back, the fly-half. The game is controlled by a referee assisted by a touch judge on each touch-line, who decides when the ball is out of play, a game consists of two periods of 30, 35 or 45 minutes each, the players changing ends at half-time, the side with the most points winning the game.

FORM IN MUSIC. When a composer composes a piece of music he is faced with the problem of making his music sound varied and at the same time making it sound like one whole piece and not just odd scraps of melody strung together. In other words, there has to be variety and balance.

One way of achieving this would be to start the music in one KEY and then let it change to another key; then to create a balanced effect, our music would continue in the new key but come back to the original key to finish off with. Such a plan gives variety and balance of key. It lets us think of the music in two sections, the first wandering away from the main key, the second coming back to it. This is called *binary form*, which means in two sections, and may be thought of as A-B.

Another simple plan would be to have a tune, follow it with a contrasting tune, and then finish off with a repetition of the first tune. Such a plan, A-B-A, gives variety and balance of tune and is called *ternary form*, which means in three sections.

Sonata form is a mixture of binary and ternary. It begins with a set of tunes, called the Exposition,



Rugby football pitch



Breakaway from a scrum

which starts in one key and changes to another (a piece in binary form would begin like this) then comes the Development, in which the composer juggles with the tunes of the Exposition and uses them in odd ways and in many keys, finally comes the Recapitulation, which is a repetition of the Exposition, but which keeps to the main key throughout. So the complete plan is —

A (Exposition with change of key)

B (Development in many keys).

A (Recapitulation keeping to the one key)

A *Rondo* simply has one striking tune which is repeated many times, with contrasting tunes between one repetition and the next, e.g. A-B-A-C-A-D-A, etc.

Sonata form is used generally in the first movements of sonatas, symphonies, concertos, and CHAMBER MUSIC. These works may have three or four movements, of which the second is generally a slow movement, the third a minuet and trio or a scherzo, and the fourth often some variant of a rondo. The form of the minuet and trio, and the scherzo derived from it, consists

of two minuets, each in itself either binary or ternary, the first minuet being repeated after the second, and the whole making one large ternary movement. The slow movement is more variable in form. Often it is in simple ternary (A-B-A), sometimes it is in the shape of an air followed by varia-

tions of the air.

FORMULAS (or formulae) are convenient ways of stating mathematical and scientific facts. Letters and symbols are used.

The formula for the volume of a sphere is $\frac{4}{3}\pi r^3$. π stands for a number, $3\frac{1}{2}$ (or more exactly 3.1416), r stands for the radius of the sphere. If the radius is 6 inches the volume is

$\frac{4}{3}\pi r^3 = \frac{4}{3} \times 3.1416 \times 6^3$ cubic inches
 $= 904.7808$ or about 905 cubic inches

We sometimes have formulas as equations. For example, $S = \frac{1}{2}gt^2$ is a formula giving the distance which an object falls when it starts from rest. S is the distance in feet, $g = 32$, t is the time in seconds. In 5 seconds a body falls $\frac{1}{2} \times 32 \times 5^2 = 400$ feet.

See **EQUATIONS**

FOSSILS are remains of animals and plants, which lived millions of years ago, preserved in stone. They include bones and shells of animals, leaves and stems of plants, even footprints of animals and traces of such delicate creatures as jellyfish and worms. Geologists know the comparative age of rocks all over the world. In the oldest rocks are found remains of the earliest

animals, in coal are tree-ferns and mosses unlike those living today, in later rocks the bones of huge reptiles long since extinct, while in the most recently formed rocks are shells and bones very like those belonging to modern animals

FOWL, a domestic bird derived from the Indian jungle fowl. Many varieties are bred, some such as Leghorns specially for eggs, while Rhode Island Reds and Light Sussex are reared both for eggs and eating

FOX See **DOG**

FRACTIONS. (1) To find half of anything we cut it into two equal parts. Two halves of a cheese make the whole cheese

$$\frac{1}{2} \times \frac{2}{2} = \frac{2}{2} = 1$$

To find a third we divide the object into three equal parts

$$\frac{1}{3} + \frac{1}{3} + \frac{1}{3} = \frac{3}{3} = 1$$

and $\frac{1}{3} + \frac{2}{3} = \frac{3}{3} = 1$
and so on

The numbers below the bar, 2, 3, 4, 5, etc., which tell the number of equal parts, are called *denominators*, because they name the fractions (half, third, fourth, fifth, etc.)

The numbers above which tell the numbers of such parts involved are called *numerators*

(2) To find $\frac{1}{8}$ of a sum of money or a number, we divide by 8. To find $\frac{5}{8}$ we multiply $\frac{1}{8}$ by 5

$$\frac{1}{8} \text{ of } £1 = 20s - 8 = 12s$$

$$\frac{5}{8} \text{ of } £1 = 12s \times 5 = 60s = 5 \text{ } 0d$$

Similarly, to find $\frac{1}{9}$ of 711

$$\frac{1}{9} \text{ of } 711 = 711 \div 9 = 79$$

$$\frac{4}{9} \text{ of } 711 = 79 \times 4 = 316$$

(3) The top line is divided into $\frac{1}{3}$ and $\frac{2}{3}$. In the next, each third is divided into halves

$$\frac{1}{3} = \frac{2}{6}, \frac{2}{3} = \frac{4}{6}$$

In each case we multiply numerator and denominator by 2

The third line shows us that

$$\frac{1}{3} = \frac{2}{6}, \frac{2}{3} = \frac{4}{6}$$

We multiply numerator and denominator by 4

The lowest line shows us that

$$\frac{1}{3} = \frac{4}{12}, \frac{2}{3} = \frac{8}{12}$$

We multiply numerator and denominator by 5

We can divide each third into any number of equal parts, and so we can multiply both numerator and denominator of a fraction by any number and keep the same value for the fraction e.g.

$$\frac{1}{3} = \frac{2}{6} = \frac{3}{9} = \frac{4}{12} = \frac{5}{15} = \frac{6}{18}, \text{ etc.}$$

We can also divide numerator and denominator by the same number without changing the value of the fraction

$$\frac{6}{12} = \frac{3}{6}, \text{ so } \frac{12}{24} = \frac{6}{12}$$

$$\frac{12}{24} = \frac{6}{12} = \frac{3}{6} = \frac{1}{2} = \frac{1}{2}$$

When a fraction is treated in this way, so that numerator and denominator are as small as possible, it is *reduced to its lowest terms*

(4) A fraction with its numerator greater than the denominator is called an *improper fraction*. We can change such a fraction into a *mixed number* (part whole number and part fraction), and we can change a mixed number into an improper fraction

$$\frac{37}{7} = 30 \div 7 = 4\frac{3}{7}$$

$$4\frac{3}{7} = \frac{4 \times 7 + 3}{7} = \frac{31}{7}$$

(5) To add or subtract fractions we give them a common denominator (a number into which each denominator will divide)

$$3\frac{3}{4} + 4\frac{5}{6} + \frac{7}{24} = \frac{7 \times 18 + 30 \times 7}{24} = \frac{126 + 210}{24} = \frac{336}{24} = 14$$

$$2\frac{1}{2} - \frac{1}{4} = \frac{2 \times 20 - 5}{40} = \frac{40 - 5}{40} = \frac{35}{40} = \frac{7}{8}$$

(6) To multiply fractions, we multiply the numerators for the new numerator, and denominators for the new denominator

$$\frac{2}{3} \times \frac{4}{5} = \frac{8}{15}, \frac{3}{4} \times \frac{1}{2} \times \frac{2}{7} = \frac{3 \times 1 \times 2}{4 \times 2 \times 7} = \frac{6}{56} = \frac{3}{28}$$

If some of the quantities are mixed

the Rhône-Saône system, the Garonne, Loire and Seine. In the fertile northern lowlands are grown grapes and fine vegetables, wheat in Picardy and oats in Brittany. Cattle are reared in Normandy, and Brittany specializes in dairy farming. On the bleak Central Plateau sheep are reared. Along the Mediterranean coast olives and fruit are grown, and farther west around Bordeaux is a region of vineyards. The sand dunes of the Landes on the west coast yield timber and turpentine. Fish, especially sardines and anchovies, are caught off the Mediterranean coast. France is almost self-supporting in food, its exports include large quantities of high quality foods and wines. Industry is concentrated mainly in the east, especially in the coalfield regions of the north-east, centres of iron and steel and textile industries, and in Lorraine and the Vosges valleys, where iron ore is found and is the basis of heavy industries. Industry has been helped by abundant hydro-electric power, and many of the railways are electrified. The Lyons region specializes in silk manufacture. Automobile and engineering manufactures are carried on around Paris.

Paris, the capital, lies on the Seine and controls road, rail and water routes to all parts of the country. It has been a centre of art and learning for many centuries. Other important towns are the ports of Le Havre and Bordeaux, while Marseilles handles all the French colonial trade and is a calling place on the Mediterranean route to the East. Cherbourg is a transatlantic terminus, Brest and Toulon are naval stations, and Lille is the largest of many industrial towns in the north-east. The Riviera coast to the east of Toulon is a world-famous tourist centre.

History France was in continual conflict with England in the Middle Ages (see HUNDRED YEARS' WAR), during which England lost all her French possessions. The 16th century was a period of civil war resulting from the REFORMATION (see HUGUENOTS), and was followed by the rise in power of the French monarchy, which was at its height in the reign of LOUIS XIV. In the struggle with Britain for overseas colonies, France became impoverished and the monarchy was swept aside in the FRENCH REVOLUTION at the end of the 18th century. From this upheaval arose NAPOLEON BONAPARTE, whose career of conquest lasted until his defeat at the hands of WELLINGTON. The monarchy was restored and lasted till 1848. Louis Napoleon then became President and later Emperor and fought an unsuccessful war against Prussia in 1870. France lost Alsace-Lorraine, territory which she regained at the end of the FIRST WORLD WAR.

In the SECOND WORLD WAR France was soon overrun by the Germans and surrendered, but General de Gaulle formed a Provisional National Committee to continue the war from abroad. His followers, the "Fighting French," helped in the ensuing struggle, and he formed a government in French North Africa when that was captured in 1943. In the elections after France's liberation, de Gaulle was unable to win agreement between the various political parties and resigned. In 1946 a new constitution, signaling the birth of the fourth republic, was accepted.

FRANCHISE, the right enjoyed by men and women of voting at elections. To *disfranchise* a person is to deprive him of this right.

FRANCIS, St. (1182-1226), of Assisi, in Italy, was a soldier who,

after a vision, accepted poverty and began preaching. He founded the Order of the Franciscans (see FRIARS), and loved all things that God had made. His love of nature was keen, and artists have often depicted him preaching to the birds.

FREE TRADE is a policy that permits IMPORTS to enter freely. Goods that are not allowed to enter freely have a customs duty or tariff imposed on them. One argument used to justify such a tariff is that it will protect a home industry. The money so obtained goes towards revenue from TAXATION.

In the 19th century, Britain believed that her best interests were served by the free entry of goods into the country, thereby putting the consumer in touch with the cheapest producer, and showing which home industries could be most profitably developed. Free traders are those who uphold Free Trade, Protectionists are those who wish to protect home industries by means of tariffs.

FREE VERSE. See PROSODY.

FREEZING MIXTURE is a mixture of a number of chemical substances which together produce a temperature lower than the freezing point of water, that is 0 deg. C. Such common mixtures are ice and salt, ammonium nitrate, sodium carbonate and water, sodium sulphate and concentrated spirits of salts, solid carbon dioxide (dry ice) and ether.

FRENCH ART. See ART.

FRENCH EQUATORIAL AFRICA is a west African region of dense forest with few people and poor communications. Timber, rubber, palm oil and ivory are exported. The capital is Brazzaville on the Congo. See the map of AFRICA.

FRENCH INDO-CHINA, territory in south-east Asia, produces

rice, teak and pepper for export, and zinc, tin and phosphates are mined. Politically it is a federation consisting of the republic of Viet Nam, the protectorates of Cambodia and Laos, and Cochinchina. Saigon, the capital, and Haiphong are the chief ports. See map of INDO-CHINA.

FRENCH KNOTS in embroidery are used for the centres of flowers or background fillings. Bring the thread through at the spot where the knot is to be placed. Hold the thread taut with the left thumb and forefinger, and twist it once or twice round the needle (see 1).



Making a French knot

Insert the needle at the point where the knot is to be (see 2), and bring it out at the position of the second knot, holding the thread firmly until all of it is pulled through, (3) shows the finished appearance of the knots.

FRENCH REVOLUTION, broke out in 1789 on account of heavy taxes, bad harvests, and general discontent with the government, encouraged by many writers of the day, and by the success of the recent American War of INDEPENDENCE.

The first act was the storming of the Bastille, a prison-fortress in Paris (14 July, 1789). Following the American example, the French Assembly issued a Declaration of the Rights of Man (August, 1789). Had Louis XVI been a strong, wise king he might have weathered the storm. Unfortunately for him he tried to escape from Paris to friends over the border (1791). This gave his enemies the upper



The French Revolution began with the storming of the Bastille

hand There were two parties among the revolutionaries the Girondists, or moderate party, wanted reforms, but did not wish to harm the king and queen, the extreme party, the Jacobins, wished to destroy all royalty and nobility

In 1793, King Louis and his queen, Marie Antoinette, were executed France became a republic A reign of terror followed But the revolutionaries began to quarrel among themselves, and in 1794, Robespierre, the leader of the Jacobins, was put to death by the guillotine

Britain and other countries declared war on France, but without any great success Then in France a young soldier, NAPOLEON BONAPARTE, began his career of conquest In 1799 he became First Consul and master of France, and the revolution was over

FRENCH WEST AFRICA, the largest West African colony, is drained in the south by the Niger and Senegal rivers, and borders in the north on the Sahara Desert Senegal is its most important province Ground nuts, palm oil products and timber are exported from Dakar, the capital See map of AFRICA

FREQUENCY. If some event, say a pulse of electric current or a rise in the atmospheric pressure, occurs at regular intervals just as a pendulum swings to and fro, then the number of times the event happens in a given time is called its frequency The frequency of SOUND waves varies from a few to thousands per second and that of electrical waves may be millions per second

FRETWORK. The fretwork outfit should include a hand-frame,

saw blades, drill, rule, compass, pincers, H B pencil, sandpaper and glasspaper, hammer, screwdriver, small file, and a cutting board

Fretsaw This is used for cutting out shapes and patterns in thin wood. As it may often be required for use on large pieces of wood, it is advisable to have a hand-frame with revolving clamps for the saw, which can thus be turned when the cutting is some distance from the outside of the wood.

Setting blades The saw blade is fixed into the clamp at the handle end first, and the top of the frame is slightly pressed while the other end of the blade is fixed, it will then become taut. The teeth of the saw point downwards.

Working the saw Only slight pressure is required to do the cutting, wherever possible start cutting at some corner. When a pointed shape is being made, cut beyond the point and, making a small circle, return to the point and continue.

Cutting board This is clamped to the table or bench. The saw blade always works in an upright position, up and down within the V-shape on the cutting board, and the wood is turned about with the free hand while cutting the shape. If a treadle working machine is available this cutting board is unnecessary as the machine has its own cutting plate.

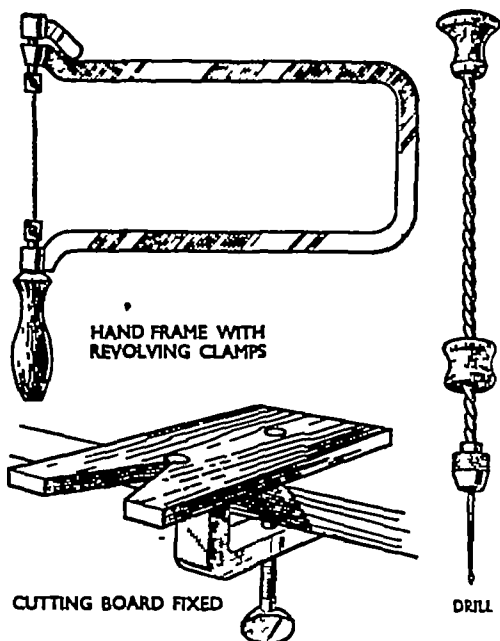
Drill Do not bore holes for receiving the blade with gimlet or bradawl. An Archimedean drill is best. The holes should not be made on the lines of the design, and should only be large enough to take the blade.

Sandpaper This should be rather fine. To use it effi-

cantly, wrap it around a flat-surfaced block of wood. Don't use the sandpaper or glasspaper on surfaces without this block, otherwise the surface you are working on will not be level.

File One or two small files of various shapes are useful, but must be used very carefully. It is very easy to spoil or break small shapes if the file is used too vigorously. Move the file more along the edges than across them, and pay great attention to what you are doing.

Patterns These may be traced or pasted on the board. It is advisable to paste the board first, then put the dry paper pattern on it, press down very quickly and keep under pressure until dry. This is to prevent the pattern from swelling or getting out of shape, and to stop the board from warping. When tracing, use a ruler for straight lines, and a compass for circles, and you will get a better result.



The most important tools for fretwork

FRIAR, a man who took vows similar to those of a **MONK**, but went about the world to preach, instead of living in seclusion. **St FRANCIS of Assisi** and **St Dominic** each founded an order of friars. See **MIDDLE AGES**

FRICTION. When two surfaces rub together, then a force called friction comes into play and tends to stop the motion. When the surfaces are both solids, friction may be reduced by putting oil between them. If the rubbing is between a solid and a liquid or gas, then friction is reduced by making the solid surface absolutely smooth. In nearly all machines a great deal of power is lost through friction; this power is converted into heat and wasted in heating up the surrounding air.

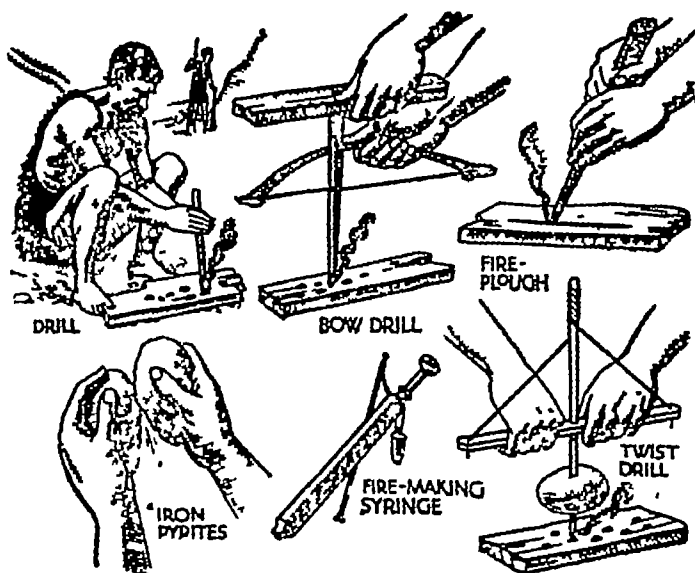
Primitive man used the heat involved in friction to make fire.

FRIENDS, SOCIETY OF. The religious Society of Friends started with the preaching in 1647 of George Fox, who spoke of "quaking at the word of the Lord." Thereupon his followers were nicknamed Quakers. They believe in the saving

grace of Christ, and do not believe in **SACRAMENTS**. They also believe that all war is unchristian. They have no ordained ministry, but at their meetings any member speaks when he feels moved to do so by the Holy Spirit. They are specially devoted to social work.

FROG, toad, newt, salamander, are **VERTEBRATES** (backboned animals) forming the class **AMPHIBIA**. They hatch from eggs into tadpoles, living in water and breathing by **GILLS**, and later change to animals which breathe partly through their skins and partly by means of lungs. These are able to live on land, but return to water to breed. Frog eggs form a mass of spawn, the tadpoles are gold-speckled. Toads' eggs form double ropes of jelly, hatching into black tadpoles. Crested, common and palmate newts lay eggs singly under water plant leaves. Their tadpoles are fragile and transparent with pink gills. Salamanders are not wild in Britain, but European orange and black ones are often kept in captivity. Amphibians are useful to man, as they eat flies and slugs as well as

worms and water animals. Frogs and toads catch insects by flicking out the sticky-tipped tongue, which grows from the front of the mouth and points down the throat when at rest. Frogs have tiny teeth in the upper jaw, toads none. Unhatched tadpoles are nourished on the yolk in the eggs, their jelly is not food.



Early methods of making fire by friction

but protection After hatching they are at first vegetarian, but soon change their diet and turn to eating small water animals, sometimes including their own companions

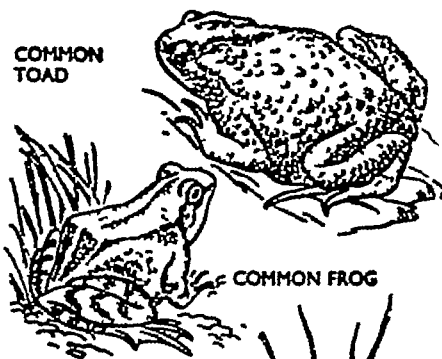
FROST. The cooling of the earth's surface to freezing point causes the water from the atmosphere, deposited during the cooling, to turn to ice-crystals on the ground and on vegetation This frozen moisture is frost

FRUIT Considered scientifically, a fruit is formed by the ripening of an ovary, but many fruits are also formed by the ripening of the receptacle or other neighbouring parts of the **FLOWER** Within it, the fertilized ovules form the **SEEDS** When these are ripe, they need to be scattered in places suitable for their growth. The scattering may be caused by wind, animals, water, or violent bursting of the fruit There is a picture showing how this is done in the article on seeds

FRUIT CULTURE When a fruit tree is to be planted in your garden, be careful to dig a hole big enough to enable you to spread the roots out Drive a stake in and tie the tree to it to give it support and press the soil down firmly after you have replaced it Insecure planting is one of the main causes of the loss of young fruit trees Spray the trees in winter with a tar-oil wash to destroy eggs of harmful insects, and, just before the buds open, with lime sulphur to prevent scab When the blossom has fallen, spray with nicotine solution to destroy apple sawfly and codlin moth **PRUNING** should be regularly and carefully carried out to encourage healthy growth

The best manure to give fruit trees is well-rotted compost or farmyard manure, applied each year around the trunk of the tree roughly beneath the circle formed by the outer branches The good-

COMMON
TOAD



COMMON FROG

GREAT CRESTED
NEWT (MALE)



Frog and near relations

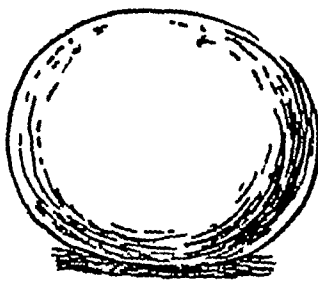
ness from this will soak through to the roots See **MANURING**

Trees should be thinned about June, some of the weaker fruit being taken off to give the strong a chance to develop into really fine specimens In general, remove the fruit which points upwards and leave that which hangs down The former is more likely to fall off before it is fully developed

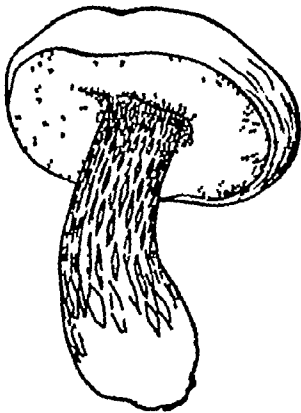
See **COMPOST**, **GREASE-BANDING**, **INSECT PESTS**, **PROPAGATION**

FUEL is combustible material such as coke and COAL, PETROLEUM and METHYLATED SPIRITS, which when burnt gives out useful heat energy

FUEL, HEATING VALUE OF. In a laboratory a sample of the fuel is burnt in a special apparatus and we can calculate as a result that a gallon of a certain fuel oil, or a pound of a certain coal, gives out so many B Th U (British Thermal Units) of **HEAT** energy



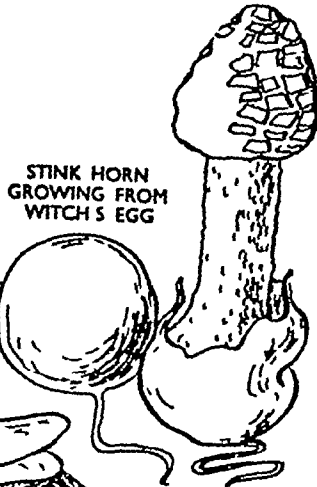
PUFF-BALL



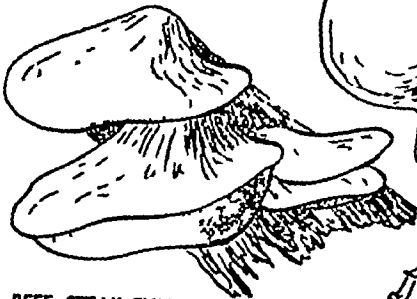
BOLETUS



DEATH CAP



STINK HORN
GROWING FROM
WITCH'S EGG



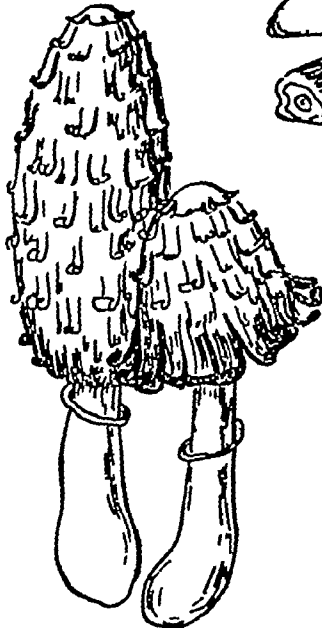
BEEF-STEAK FUNGUS
ON DEAD TREE



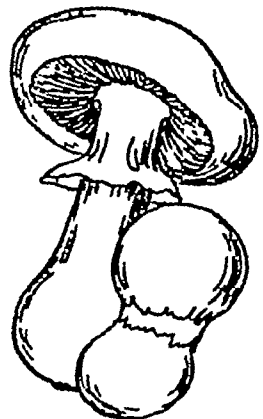
OYSTER FUNGUS
ON DEAD WOOD



FLY AGARIC



INK CAP



MUSHROOM

Some common kinds of fungus, a group of lowly plants which feed on decaying matter or live as parasites on plants and animals

This figure is called the calorific or heating value of the fuel

FUGUE, a musical composition arranged for several voices or parts. A melody is given out, and is then repeated at another pitch by a second voice or instrument (or different part of the keyboard). A third or even fourth voice may take up the melody until there are three or four different strands of music running together. Many fugues are written for the organ. See **COUNTER-POINT**

FUMIGATION is the cleansing of a building or ship by sealing it up and filling the interior with a gas poisonous to vermin. The gases used include sulphur dioxide, and vapours from cyanides and formaldehyde

FUNGUS. Mushrooms, toadstools, moulds, mildews, rusts and yeasts are all fungi, members of a very large group of lowly plants, a number of which are poisonous when eaten. No fungus can feed as normal plants do, since none contains **CHLOROPHYLL**. Fungi absorb their food from decaying matter, or grow as **PARASITES** on living plants or animals. A typical fungus consists of a mass of minute, white, branching threads, which form reproductive bodies. Every toadstool or puffball is the reproductive part of one kind of fungus, and produces masses of dust-like spores from its gills or inside it. Each spore can grow into a new branching thread to form another fungus. Not all are harmful, the yeasts are much used by man in brewing and baking, and one mould, penicillin, has been used with marvellous results in medicine.

FURNITURE. Changes in furniture may be divided into three stages (1) the age of woodcraft, (2) the age of design influenced by architecture, and (3) the modern

age stressing fitness for purpose.

In the 16th century furniture developed from the square box stool and the chest-bed to chairs, couches and tables. They were made mostly from oak and had carved legs. In the 17th century—the Jacobean period—carving became more elaborate, and in Charles II's reign the use of walnut was introduced with twist-turned legs and rails. Later, in William and Mary's reign, the legs were scrolled and padding (upholstery) was added for comfort. In Queen Anne's reign we get the distinctive cabriole legs, curving out like an animal's and often with claw feet.

In the middle of the 18th century furniture design came under the influence of the architects, and we had such great names as Chippendale, with his open-work panels at the backs of chairs, Hepplewhite, with fine straight legs and shield-shaped backs, and Sheraton, who designed in walnut and satinwood. They were influenced by the Adam brothers, great architects of the period who used delicate ornamentation such as ovals, medallions, shells and vases. They introduced painted furniture, and designed houses complete with all their contents in every detail.

During the Victorian era furniture design deteriorated into a clutter of ornament and a mixture of styles.

William MORRIS, a poet and architect and a great believer in handicrafts, tried in the 1860s to bring furniture back to the fine tradition of the Middle Ages, but without much success. The machine age in furniture was beginning, and since then fitness for purpose has been the guiding principle in the design of furniture, which tends to be simple, straightforward and plain. See pictures on pp 246-248



Furniture design, like fashion in dress, changes from age to age, altering



the appearance of the home here are some of the main styles See p 245



ADAM STYLE



MODERN STYLE

The simple design of today's furniture shows fitness for purpose



GALILEO (1564-1642) was one of the first experimental scientists

The telescope which he constructed showed him that the astronomical ideas of the time were incorrect, and his writings to explain his theories about the movement of planets, particularly his belief that the earth travels round the sun, and not vice versa, were thought to be contrary to the teachings of the Church, and led to his trial for heresy by the Inquisition

GALSWORTHY, John (1867-1933), novelist and playwright Educated at Harrow and Oxford, he became a barrister, but practised little

His first published work was *The Island Pharisees*, but he is best known for the series of novels on the Forsyte family over three generations, collectively called *The Forsyte Saga*, and *A Modern Comedy* The whole series appeared between 1906 and 1928, and gives a picture of a well-to-do middle-class family and how changing society affected it

Galsworthy's plays usually presented a social problem The best known are *Strife*, the theme of which is an industrial dispute, *Justice*, a criticism of the prison system, and *The Skin Game*, in which the standards of an old-established family and one newly rich come into conflict

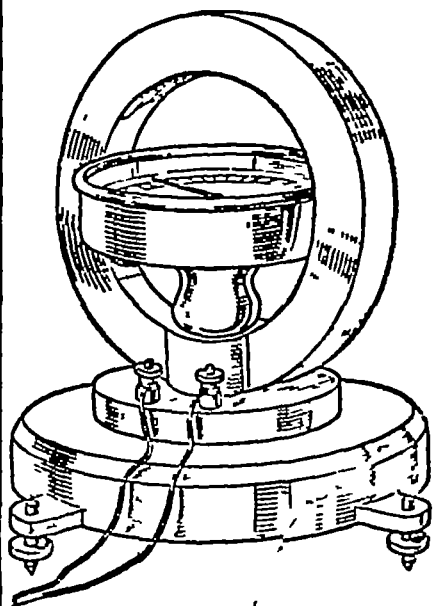
GALVANOMETER (galvo), a current detector, usually very sensitive and delicate There are several types, but the moving magnet type is easy to understand and make A coil of wire joins the two terminals, and through it passes the current to be detected and measured This coil is made into a MAGNET by

the current, and therefore the small magnet which is in the centre of the coil tries to turn at right angles, but is held back by a control magnet The bigger the current, the more the magnet and the pointer joined to it will turn

Such a galvo will, if carefully constructed, detect a thousandth part of an AMPERE

GAMBIA is a British protectorate in West Africa extending along both banks of the Gambia River, the chief means of communication Ground nuts and palm oil are exported from Bathurst, the capital See map of AFRICA

GANYMEDE, in CLASSICAL MYTHOLOGY, is a beautiful Greek youth who was carried off by JUPITER's eagle to become cup-bearer to the gods on OLYMPUS, in place of Hebe, the goddess of youth, who married HERCULES



Galvanometer measuring current

GARDENING. Gardens were cultivated in India and China thousands of years ago, and there is proof of the existence of gardens in ancient Egypt, Assyria, Babylon, and Greece in the distant ages when those nations were mighty. The Romans were famed for the beauty of their gardens and parks, and introduced the art of gardening into Britain, teaching the Britons how to grow fruit and vegetables previously unknown to them.

A new garden should be begun quite simply with only a small number of plants, and should be added to as knowledge and experience increase. See **HERBACEOUS BORDER**, **LANDSCAPE GARDENING**, **LAWN**.

Digging and trenching virgin soil is hard work, but these operations are necessary before the soil can be brought into a fit condition to receive the plants. Seed should be bought from a reliable source. It should be fresh. Vegetable crops should be grown in different parts

of the garden in succeeding years in order to get the best results, and the **SOIL** should be enriched by **MANURING**. **INSECT PESTS** lurk in the ground and above it ready to feed on the young plants and prevent them from reaching maturity. If plants are to grow up healthy and sturdy, they must have sun, air and water, and must also be kept free of **WEEDS**.

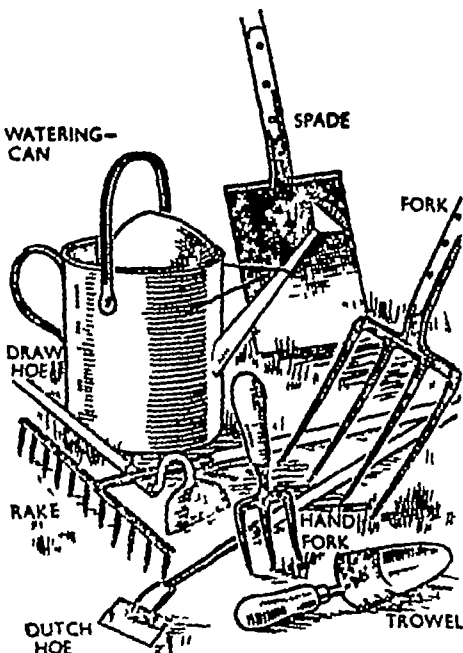
See also **ALLOTMENT GARDENING**, **DIGGING**, **DOUBLE DIGGING**, **FERTILIZERS**, **FLOWER GARDEN**, **FRUIT CULTURE**, **PROPAGATION**, **ROTATION OF CROPS**, **SEED**.

GARDENING TOOLS should be of a size that the young gardener can handle comfortably. The chief work for spade and fork is the **DIGGING** and turning over of the ground during the winter months, though a constant use will be found for both all the year round. The Dutch hoe is probably the most useful tool in the garden and it should be used throughout the growing season to keep down **WEEDS**, let air into the **SOIL** and keep it moist. A rake is necessary for smoothing the soil surface prior to sowing, and a small handfork and trowel are convenient to handle when **TRANSPLANTING** or **THINNING** out young plants. A good strong line attached to steel or wooden pegs simplifies the sowing of seeds in straight rows, and a watering can with a detachable rose permits either concentrated watering through the spout or sprinkling through the rose.

All tools should be kept clean and sharp. After use the soil should be scraped or washed off and the blades and prongs rubbed with an oily rag.

See **ALLOTMENT GARDENING** and **GARDENING**.

GARRICK, David (1717-1779), was a pupil and friend of Dr.



Gardening tools you must have

JOHNSON, whom he accompanied from Lichfield to London

He eventually became the greatest actor of his age, a leading light in



Garrick, 18th-century actor

Johnson's circle, and is buried in Westminster Abbey

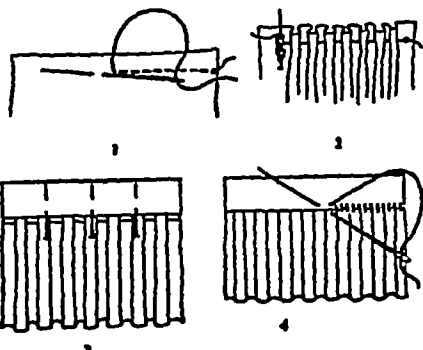
GARTER STITCH. See **KNITTING**

GAS is the state of **MATTER** in which the molecules are so free to move that they will always seek to fill the space in which the gas is contained. See **KINETIC THEORY OF GASES**. Generally speaking, a gas is formed by raising the temperature of, or reducing the pressure on, a liquid

See also **COAL GAS**

GAS MANTLE, a small fragile net of combustible thread which has been soaked in salts of thorium and cerium. When the mantle has been placed in position at the end of a gas jet and the thread burnt off, all that remains is a delicate skeleton of the oxides of the two metals. This glows brightly when the gas is lit. See **LAMP**

GATHERS. The material to be gathered should be twice the width required when finished. Beginning with a **BACK STITCH**, run along a crease about $\frac{1}{2}$ inch from the edge, on the right side of the material to be gathered (see 1). Pull up the gathers, and wind the end of the thread round a pin placed vertically at the end of the row (see 2). Stroke the gathers even with the eye of a fine darning needle, beginning at the left-hand side. Unwind the thread and let out the gathers to the length of the band into which they are to fit, and which has been divided equally into four. Secure the quarters in position with pins put in vertically (see 3). Set the gathers in with setting-in stitch (see 4) to do this, begin as for **HEMMING**, then take up the edge of a gather close to the band with the needle parallel with the band, turn the needle round so that it is almost vertical, and take up the edge of the band. This turn of the needle lifts up each gather. On the wrong side use setting-in stitch to



How to make gathers

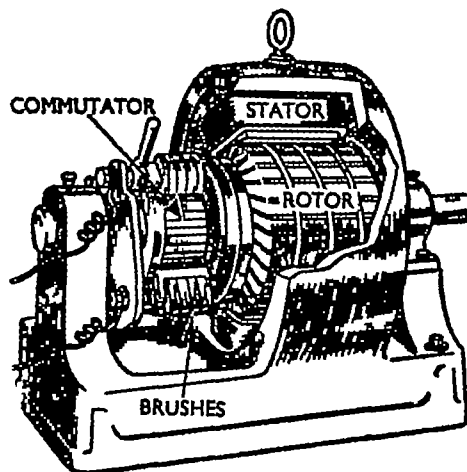
fix into position. These stitches, however, should not be taken through to the right side of the material or they will pull the band.

GAVOTTE, a dance starting on the third beat of a four-pulse

measure, often added to the dances which make up a SUITE

GELATINE is a PROTEIN extracted from bones with hot water Its solution sets when cool It is used when purified as the basis for edible jelly In its less pure forms it is used for SIZE and ordinary GLUE

GENERATOR, a machine which generates electricity In a direct current generator, a rotor consisting of coils wound on an armature of



Direct current generator

soft iron rotates in a powerful magnetic field set up between stationary magnets, the stator. The current from the coils is led to a commutator where it is picked up by fixed carbon or copper brushes and taken to outside terminals. Some of this current is tapped off to magnetize the main field magnets between the poles of which the armature and coils rotate.

In an alternating current generator, called an alternator, it is the magnets which revolve and form the rotor, while the armature remains still and so forms the stator.

Generators are driven by steam engine, oil engine, or by water-power. See HYDRO-ELECTRICITY.

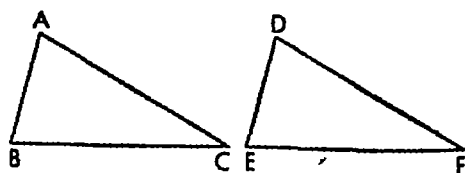
Thus a generator is a means of converting mechanical energy into electrical energy. See ELECTRO-MAGNETISM.

GEOGRAPHY is the study of the earth's surface, the relationships between its land, water, air, plants, animals and people. Special branches include human, physical, plant, animal, economic, historical, mathematical, regional and political geography.

GEOLOGY is the science which deals with the structure of the globe and the substances which compose it. See ROCK.

GEOMETRY deals with lines, ANGLES, and various figures: circle, triangle, square, etc. We begin by assuming certain facts to be self-evident truths, and then use these facts to prove other facts. The facts we prove are called propositions, and general conclusions are theorems. Here are some important propositions.

Congruent triangles Two triangles are congruent when one fits exactly over the other. The sides of one equal the sides of the other, the angles of one equal the angles of the



other. The triangles ABC and DEF are congruent $AB = DE$, $AC = DF$, $BC = EF$. Angle $A =$ angle D , angle $B =$ angle E , angle $C =$ angle F . Area $ABC =$ area DEF .

Two triangles are congruent:

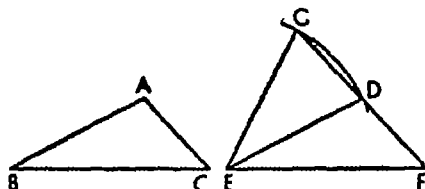
(1) when two sides and the included angle of one equal two sides and the included angle of the other, e.g. $AB = DE$, $BC = EF$, angle $B =$ angle E ,

(2) when the three sides of one equal the three sides of the other,

e.g. $AB = DE$, $AC = DF$, $BC = EF$

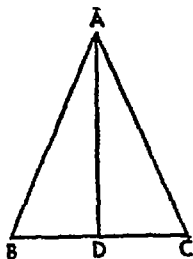
(3) when one side and two angles of one equal one side and two angles of the other, the situation of the side with respect to the angles being the same, e.g. when $BC = EF$, angle $B = \text{angle } E$, angle $C = \text{angle } F$, or when $AB = DE$, angle $A = \text{angle } D$, angle $C = \text{angle } F$

(4) There is a fourth case when we have two sides of one equal to two sides of the other and one angle, not the included angle, equal,



e.g. $AB = DE$, $BC = EF$, angle $C = \text{angle } F$. This is called the "ambiguous case," because it is possible to have two different triangles which fulfil these conditions. We can have FD or FG for the third side, because either ED or EG is equal to BA .

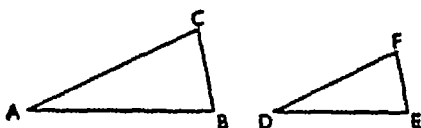
As an example of the use of congruent triangles, ABC is an isosceles triangle (see TRIANGLE) with $AB = AC$. Find D , the mid-point of BC , $BD = DC$. Join AD , and we have the two triangles ABD , ACD . $AB = AC$, $BD = DC$, AD is common to both triangles.



Hence the triangles are congruent. The base angles, B and C , are equal. Angle $BAD = \text{angle } CAD$, so AD bisects angle BAC . Angle $ADB = \text{angle } ADC$, so these are right angles.

Similar triangles have only their angles equal to one another. Tri-

angles ABC , DEF are similar.

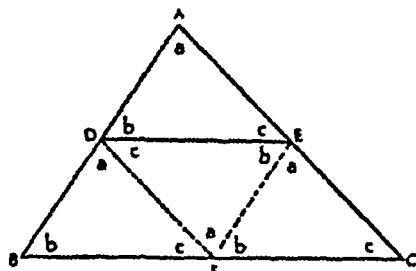


Angle $A = \text{angle } D$, angle $B = \text{angle } E$, angle $C = \text{angle } F$.

The sides are proportional

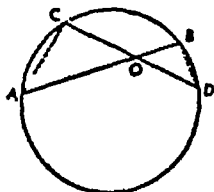
$$\frac{AB}{DE} = \frac{AC}{DF} = \frac{BC}{EF}$$

In the next triangle D is the mid-point of AB , and E of AC . Triangle



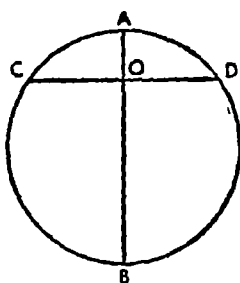
ADE is similar to ABC . Angle $ADE = \text{angle } ABC$ and angle $AED = \text{angle } ACB$ (see PARALLELS). Also DE is parallel to BC and equal to half BC . F is the mid-point of BC , so EF is parallel to AB and equal to half of AB . DF is parallel to AC and equal to half of AC . The angles marked a are equal, so are those marked b , and those marked c .

Circles AB and CD are two chords intersecting at O . See CIRCLE. Triangles OAC and ODB are similar. $OA = OB$ (the rectangle having sides equal to OA and OB)

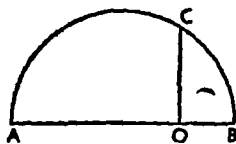


is equal in area to $OCOD$ (the rectangle having sides equal to OC and OD). Check this by drawing two chords and measuring the sides, and then multiplying

Here is a special case of the last proposition AB is a diameter, and CD is a chord at right angles to it, $OC = OD$



$$AO \cdot OB = OC \cdot OD = OC^2$$

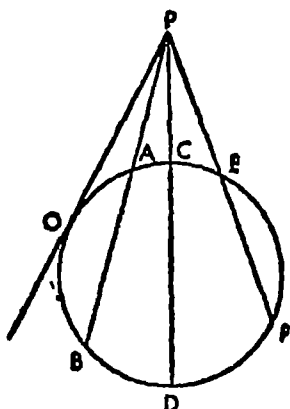


This diagram is half the previous one, turned round, it is useful to

remember the equation in the following form:

$AO \cdot OB = OC^2$. This would apply if ABC were a triangle with a right angle at C and CO perpendicular to AB

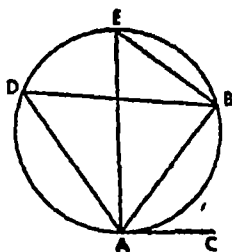
P is a point outside a circle PO is the tangent from P , touching the



circle at O PB , PD , PF are secants cutting the circle at A , B , C , D , E , F .

$$PO^2 = PA \cdot PB = PC \cdot PD = PE \cdot PF$$

Here is an interesting proposition about the angle between a chord BA and the tangent AC at the point where



the chord meets the circumference This angle BAC is equal to the angles in the segment $ADEB$ Angle $BAC =$ angle $BDA =$ angle $BEA =$ any other angle in the segment

GEORGE, St, the patron saint of England, is said to have been a native of Cappadocia (Asia Minor), of noble birth, and a soldier in the Roman Army, and when the Emperor Diocletian began a persecution of Christians, George boldly rebuked him, and confessed himself a Christian It is said that the Emperor ordered him to be tortured and martyred at Lydda, in Palestine, on 23rd April, 303. The shrine of St. George at Lydda was a place of pilgrimage to the CRUSADERS, and his fame was recognized by the Moslems The story of St. George and the Dragon is mentioned in the Golden Legend, which tells how he slew the dragon, discarded his knight's habit, and gave all he had to the poor and devoted himself to preaching Christianity.

St George's Day, 23rd April, first became a national festival in 1222, and in the reign of Edward III St George became the patron saint of England

GEORGE I (reigned 1714-1727) was a German prince, and grandson of James I He became Elector of Hanover in 1698. He was the nearest Protestant in line of succession to the British crown at the death of Queen Anne. During his reign Robert Walpole became what may be regarded as the first Prime Minister Other events were the JACOBITE rising of 1715 in favour of the exiled Stuarts, and the South Sea Bubble (1720), a financial swindle which ruined thousands

GEORGE II (reigned 1727-1760) was a brave soldier, and headed the British troops at the Battle of

Dettingen His reign saw the foundations of British power laid in India by the work of CLIVE, and in Canada, Wolfe's victory at Quebec won this great Dominion in North America Another event of the reign was the JACOBITE Rebellion of '45, when Bonnie Prince Charlie made a daring attempt to recover the Crown his grandfather had lost In this reign the great INDUSTRIAL REVOLUTION—the age of steam and of factories—was fast developing

GEORGE III (reigned 1760-1820) had one of the longest reigns in British history He was the grandson of George II, his father had died in 1751 Unlike George I and George II, he was born and educated in England, and because of his interest in farming he was often called "Farmer George"

The reign of George III is of great importance It saw the war of INDEPENDENCE of the United States, the FRENCH REVOLUTION, the completion of the winning of Canada, and the growth of British power in India under the Governors-General Warren Hastings, Cornwallis and Wellesley The voyages of Captain Cook to the South Sea (1768-1779) opened the way for future British colonies in Australia and New Zealand

The Napoleonic wars raged in Western Europe and WELLINGTON held on in the Peninsula (Spain and Portugal) NELSON won his great naval victories, defeated Napoleon's navy off the Nile (1798), and was killed in his last famous victory off Cape Trafalgar (1805) which saved Britain from invasion Wellington finally defeated NAPOLEON at Waterloo (1815)

At home great changes were taking place through the Agricultural and INDUSTRIAL REVOLUTIONS The invention of new machines for spinning and weaving,

and the use of steam to drive machinery destroyed cottage industries, and led to the setting up of many new factories and the rapid growth of towns and slums The enclosure and hedging of land (to replace the old open and hedgeless field-strips) robbed many cottagers of their bit of land and the right to graze animals on the common But farming improved, and the growing of turnips and other "roots" made possible the feeding of cattle in winter to provide fresh, instead of salted, meat The Corn Laws (1815) prevented the importation of foreign corn until English wheat reached a high price, this made bread dear, and caused much discontent

During the later years of his life, George III suffered from attacks of insanity, and his eldest son, George, Prince of Wales, was appointed Regent in 1811

GEORGE IV (reigned 1820-1830), eldest son of George III, succeeded his father in 1820, after being Prince Regent for nearly ten years He was very extravagant, and unpopular with his subjects He died in 1830, and was succeeded by his brother William IV

GEORGE V (reigned 1910-1936), the son of King Edward VII, served in the Royal Navy from 1879 until 1892 He married Princess Mary of Teck, and was made Duke of York The Duke and Duchess visited Australia, South Africa, and Canada in 1901 In June, 1910, his father Edward VII died, and he became king as George V The following year he visited India, the first reigning sovereign to do so During the First World War, he often visited the Western Front

In 1935, King George and Queen Mary celebrated their Silver Jubilee—twenty-five years as King and Queen King George V died the following year, much beloved by



Map of former Germany, showing parts now controlled by Poland and Russia

his people throughout the whole world

GEORGE VI, the second son of George V, succeeded to the throne in 1936 on the abdication of his brother, **EDWARD VIII**. He had married, in 1923, Lady Elizabeth Bowes-Lyon. During the Second World War, he visited his troops in Africa, and set a magnificent example to his people by his courage, faith and hard work throughout the war. He has two daughters, Princess **ELIZABETH**, the elder, married to the Duke of Edinburgh, and Princess Margaret.

GERMANY consists of a broad northern plain, rising through forested plateaus in the south to mountains at the Swiss and Austrian borders. It is drained northward by four great rivers, the Rhine, Elbe,

Oder and Weser. On the northern plain, heaths and pine plantations alternate with cattle pastures and fields. Rye, oats, wheat and potatoes are the chief crops. In south-west Germany fertile plains alternate with forest including the famous Black Forest, on the Rhine near the Moselle are vineyards, cereals and tobacco are cultivated and other fruits are also grown. The Rhine valley is the most populous part, and has several busy river ports, such as Mannheim, Cologne and Dusseldorf. The Ruhr area is a region of coalfields and heavy industry, and has many important towns, including the iron and steel towns of Cologne, Essen and Dortmund. Textiles are made in the Ruhr and in the Saxony coalfield region farther south, the chief

towns in this area are Munich, Nuremberg and Dresden. Other important towns are Frankfurt-on-Main, in the Rhineland, Leipzig, at the eastern end of the plateau, and Berlin, the capital, which lies in the middle of the northern plain. Coal is also mined in Silesia. The chief ports are Hamburg, Bremen and Emden, near the mouths of the Elbe, Weser and Ems, on the North Sea.

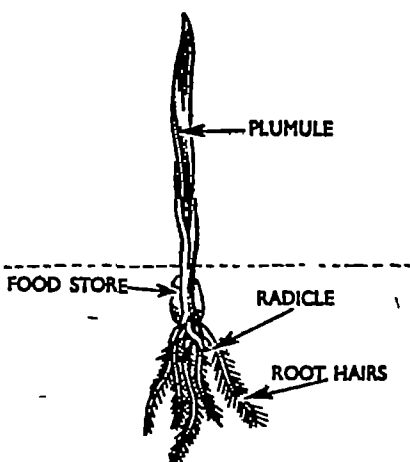
History For a thousand years (from Charlemagne to Bismarck) Germany was not a united nation, but a mass of small states, duchies, etc. She (with Italy) was the last of the great nations to be born. The German Empire in the modern sense was proclaimed in 1871, at the close of the Franco-Prussian War, by the Prussian statesman, Prince Bismarck, who became the Imperial Chancellor. The King of Prussia became the first German Emperor as William I. He was a member of the Hohenzollern family which came to the fore after the Middle Ages. The kingdoms of Saxony, Bavaria and Württemberg, and several grand duchies were united with Prussia in the Empire.

After his defeat in the FIRST WORLD WAR, William II, the third German Emperor, abdicated and retired to Holland, and Germany for a short time became a republic. Germany's defeat and the severe terms of the Peace Treaty, together with unemployment, discontent and bad management led to unrest, and the National Socialist Party (the Nazis) was formed under the leadership of Adolf Hitler. He became Chancellor of Germany, and on the death of President von Hindenburg he became supreme ruler with the title of Führer (Leader). Germany and Italy formed an alliance, known as the Berlin-Rome Axis, they were later joined by Japan in

an Anti-Comintern pact directed against communism. Austria was annexed in 1938, and German troops marched into Czechoslovakia in 1939.

In September, 1939, the Germans entered Poland, and the SECOND WORLD WAR began. Hitler became master of most of Western Europe—except Britain, which stood out alone against him in that critical year of 1940-1941, during which was fought the air Battle of Britain. The war ended with the complete defeat of Germany in 1945 through the efforts of British, American, Russian and French troops.

GERMINATION is the development of a SEED and its growth into a SEEDLING. To germinate, a seed



Seed germinating into a seedling

must have sufficient moisture and air and warmth. Water must be absorbed till the seed's weight is often doubled. Then the young root (radicle) is pushed out through the seed-coat (testa). It grows downwards, and the young shoot (plumule) next begins to grow upwards towards light. Seed-leaves (cotyledons) may remain underground with the food-store, e.g. broad bean, or grow upwards with

the plumule, e.g. cress. The root hairs seek food and moisture in the soil for the plant. If seeds are germinated in boxes in a COLD FRAME or a GREENHOUSE, a seed compost should be used to help rapid germination. The tiny shoot has to force its way through the soil to find the light, and it should be helped and never hindered in this task.

GEYSERS, common where volcanic activity is decreasing in strength, are caused by water accumulating in deep cracks and being converted into steam by the great heat underground. The steam suddenly expanding blows up through the crevices, bearing heated water with it. Geysers occur in Iceland, the North Island of New Zealand, and the Yellowstone National Park in America.

GIBBON. See APE.

GIBRALTAR, captured by England in 1704, is a small promontory of fortified rock commanding the Mediterranean at the south-west tip of Spain. It is only three miles long and less than a mile wide, but it contains a town and has a huge harbour of great naval value.

See the map of the IBERIAN PENINSULA.

GIGUE. See SUITE.

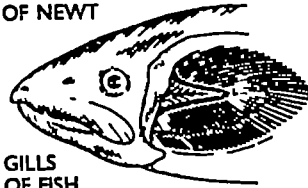
GILBERT AND SULLIVAN. W. S. Gilbert (1836-1911) and Arthur Sullivan (1842-1900) were author and composer respectively of a series of comic OPERAS with humorous verses set to light music. Among the most celebrated are *The Mikado*, *H. M. S. Pinafore*, *The Pirates of Penzance*, and *The Yeomen of the Guard*. The operas have all achieved world-wide popularity, and are constantly being revived.

GILL. Aquatic animals (i.e. living in water) generally breathe their oxygen dissolved in water. Gills are

outgrowths of thin skin through which the blood circulates, taking up oxygen and giving out carbon dioxide, as it does in the lungs of



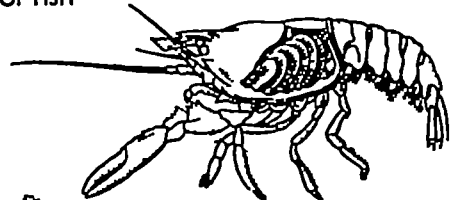
TADPOLE
OF NEWT



GILLS
OF FISH



LARVA
OF MAY-FLY



GILLS OF THE CRAYFISH



SEA-SLUG
(THE ROUGH SEA LEMON)



SEAWORMS

These all breathe through gills

land animals. Fish gills grow from bony gill-bars, between which water passes from the mouth. They are protected by a bony gill-cover. Tadpoles grow branched gills floating out into the water, which are usually replaced later by fish-like internal gills. Many aquatic insect larvae like caddises and may-flies, many marine molluscs and worms, besides crabs, lobsters and their relations, depend on gills for breathing.

See also FISH, FROG and MOLLUSC.
GIRAFFE. See HOOFED MAMMALS.

GIRDER. A simple beam laid between two walls or posts will support a certain amount of weight on top of it. If the beam, however, can be made lighter without reducing its strength, it is much more

useful than before. A girder is like a beam with the parts which are not carrying much of the load removed. It has been reduced greatly in weight but not much in strength. Small girders are rolled out of solid billets or bars of metal. See METAL (FABRICATION OF). But larger ones are built up by riveting together plates or strips and angle steel.

GIRL GUIDES. Girls between the ages of eight and twenty-one can join the Guide Movement as Brownies, Guides or Rangers. The Guide Movement for girls was a natural development of SCOUTING for boys started by Baden Powell.

Guide companies consist of about twenty to thirty girls, divided into patrols of six with an elected leader, they have weekly meetings and aim to camp at least once every year. Guides work for tests and proficiency badges covering many activities, and find fun and adventure in undertaking "to do a good turn to someone at least once every day." See page 511 where the Guide's uniform is compared with the Scout's.

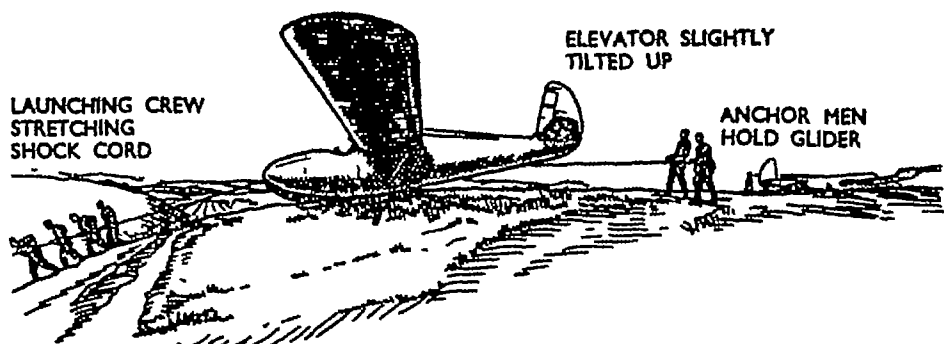
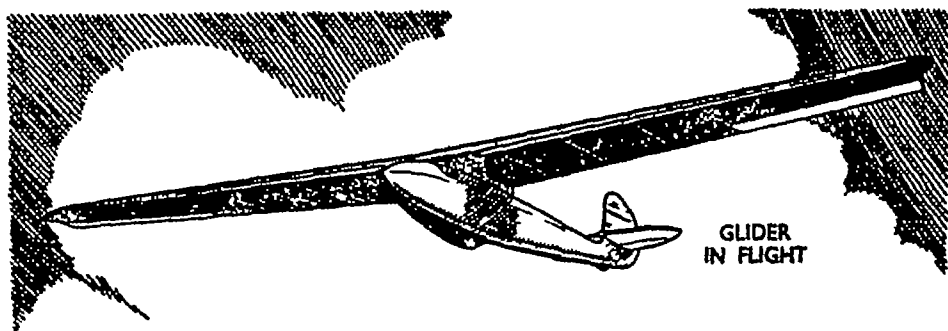
GLACIER, a slow-moving river of ice. When snow accumulates to a great thickness, the pressure turns the lower layers into ice which is inch by inch pushed out in wide tongues or glaciers. The glacier may carve a new valley, or creep along an old river valley. Stones and debris eroded by frost and rain (see EROSION) collect on the edges of the glacier, forming ridges called lateral moraines. A medial moraine is formed when two glaciers meet and their lateral moraines join. On reaching warmer regions, the end of the glacier melts and the rock material is deposited as a terminal moraine. If a glacier reaches the sea, masses of ice break off and float away as ICEBERGS.



Gladstone, Victorian statesman

GLADSTONE, William Ewart (1809–1898), an outstanding statesman of the 19th century. He was the son of a Liverpool merchant, and entered the House of Commons as Conservative Member for Newark in 1832. Later he became a Liberal. He was four times Prime Minister. He is chiefly remembered for his attempts to give Home Rule to Ireland. His great political opponent was DISRAELI. He retired into private life in 1894.

GLAND, usually a group of CELLS which give out a substance of use to the body. Some glands are single cells set in the skin, others are made up of many cells, and may form large structures such as the liver. Some glands, like sweat glands (see SKIN) and salivary glands (see DIGESTION), pour their secreted substances through ducts. Others pass secretions directly into the blood, which carries them to the appropriate places. Such ductless glands include the pituitary, controlling growth and the onset of maturity, the thyroid, controlling development, and certain cells in the pancreas which form INSULIN.



One glider is about to be launched while another soars above

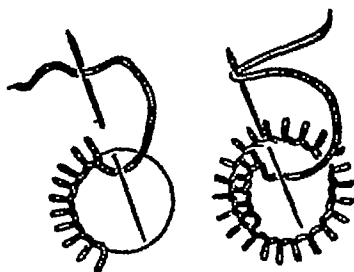
GLASS is a solid transparent substance made by fusing together sand, lime and soda. Articles of glass are made by blowing, rolling and casting the mixture whilst it is hot and plastic.

GLENDOWER, Owen. See **HENRY IV** and **HENRY V**.

GLIDER, an engineless **AEROPLANE**. In order to rise from the ground a glider must either be towed by a powered plane or thrown off at a high speed with a catapult. If the glider can get into a rising current of air, then it will maintain and even gain height. Skilful pilots have in this way remained in the air for long hours, risen to heights of thousands of feet, and flown hundreds of miles. One or even several gliders can be towed in line behind an aeroplane, enabling a glider train to deliver a cargo much greater than that which a single aeroplane can lift.

GLOVES, TO MEND. *Chamois or leather gloves*—for a straight tear,

work **BUTTONHOLE STITCH** along each edge of the tear and join the buttonholing by sewing the knots carefully together. For round holes, beginning from the edge work buttonhole stitch round and round until the hole is filled. The neatness



The way to mend gloves

of this mend depends on taking up each loop in the previous row. *Knitted gloves*—thin places and small holes should be darned. If the fingers of hand-knitted gloves become worn, the weak part may be cut away and the stitches put on three needles and the finger re-knitted. *Fabric gloves*—thin places

and small holes should be darned on the wrong side See DARNING and KNITTING

GLOW-WORM. See BEETLE

GLUCOSE is a type of sugar found in honey and fruits, and much used in making jam and confectionery

GLUE is a strong adhesive usually of crude GELATINE and applied to wooden and other surfaces to be joined Other forms of glue can be made from starchy or sugary materials, from dissolved CELLULOSE or from casein, which is a milk product

GLYCERINE is a sweet, syrupy, ORGANIC liquid, the basis of all fats and oils and a by-product of soap manufacture It is used in medicine and the manufacture of cosmetics and explosives

GNAT. See FLY

GOD. From the most ancient times men have tried to explain the universe by believing that it was created by supernatural beings—"the gods" The Jewish conception of a single, universal and all-powerful God is comparatively modern At first even the Jews believed that every nation had a different God, and that God did not mind how people behaved and what they thought, provided they offered sacrifice But such prophets of Israel as ISAIAH and Amos taught that there was only one God, who ruled all nations, and was holy, wanting men to serve Him with all their hearts JESUS, the founder of Christianity, taught that this God is the Father who creates, and loves all men He taught this by His stories and miracles, still more, in Christian belief, by His way of life and by laying down His life for all men

GOETHE, Johann Wolfgang von (1749-1832), Germany's greatest literary figure, poet, dramatist and

novelist, influenced in turn by the romantic and classic spirit, his greatest work was the dramatic poem *Faust* A man of broad genius, he was a minister of state to the Prince of Weimar and scientific discoverer in botany, optics and anatomy

GOLD is a yellow metallic ELEMENT, so malleable that it can be beaten into fine leaves through which light will pass It is not easily corroded or attacked by chemicals, and is therefore sometimes used for tooth fillings Alloyed with other metals to harden it, it is used for jewellery

GOLD COAST, a West African British colony, forest in the south and SAVANNAH in the north Cocoa,



Goethe, famous German writer

manganese, gold, nut oil, timber and diamonds are produced in the south. The chief towns are Accra, the capital, Kumasi, the cocoa centre, and the port of Takoradi. See map of AFRICA.

GOLDEN FLEECE, in CLASSICAL MYTHOLOGY the fleece of the ram which carried off to safety two children, Phrixus and Helle, whom their step-mother wished to sacrifice. Helle fell into the sea (now called the Hellespont) but Phrixus arrived in safety at Colchis. The ram was sacrificed and its fleece hung on an oak tree in the wood of Mars. To fetch this fleece home to Greece was the purpose of the famous voyage of the ARGONAUTS.

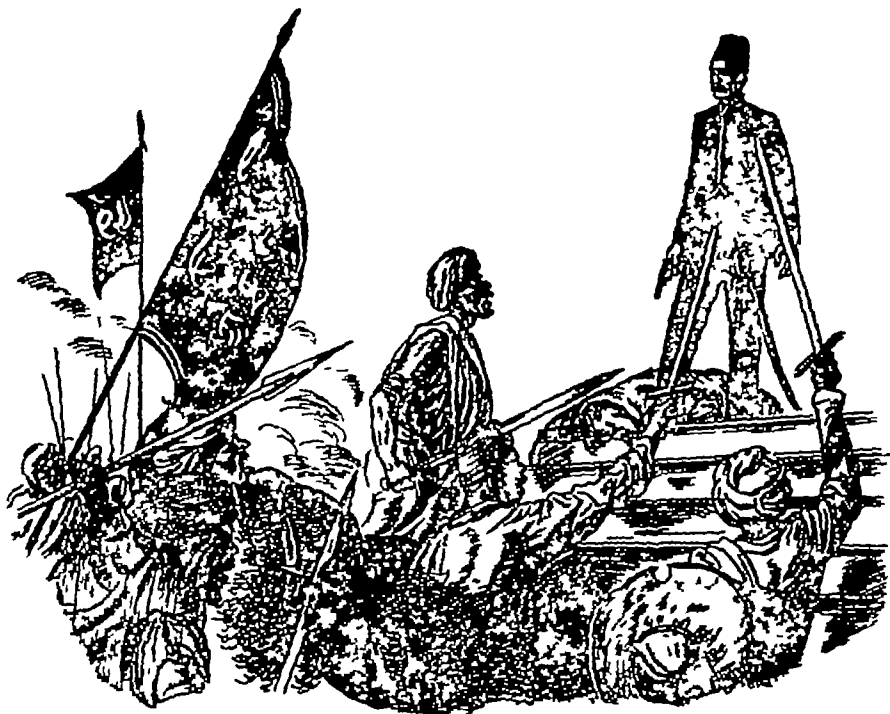
GOLDSMITH, Oliver (1730-1774), was a feckless but charming Irish ne'er-do-well who, having failed to earn a living by a dozen jobs, including begging his way round Europe with a flute, made good as a hack-writer soon to be essayist, novelist, poet and dramatist. He became, too, a friend of Dr Johnson who provided his epitaph—"He adorned whatever he touched." Goldsmith's single novel, *The Vicar of Wakefield*, netted him £60 which saved him from a debtor's prison. It has never ceased to sell since 1766. *The Deserted Village*, his best-known poem, gives a picture of the wholesale emigration from Ireland. It is as a richly comic dramatist, however, that he won widest fame. *The Good-natur'd Man* was a moderate success. *She Stoops to Conquer* has remained a classic of the theatre.

GOLF, a ball game played on a large outdoor course by one or several players, usually not more than four. The game is played with a little white ball having a rubber core with gutta-percha casing, which is hit with clubs which vary in shape for different shots, e.g. a

driver is used for long-distance shots, an *iron* for medium shots, and a *putter* for putting the ball finally into the hole. To start, each player places his ball on a mound of sand or a wooden peg (the *tee*) and drives the ball as far as he can, trying to keep the ball in the *fairway* of short grass and not get it into the *rough*, where it may get lost (which means a stroke forfeited), or be difficult to get out. There are other hazards such as *bunkers* (natural or artificial obstacles—sandpits, banks of earth, etc.), or clumps of trees, ponds, streams, etc. The $4\frac{1}{4}$ -inch diameter hole into which the ball is to be putted is in the middle of a little smooth lawn, the *green*; the player who holes the ball with the smallest number of strokes wins that hole. The player winning the most holes wins the game. The length of a *hole*, i.e. from *tee* to *green*, varies between 100 and 600 yards, and even more. A course has either nine or eighteen holes. Sometimes it is the total number of strokes taken for the whole course of eighteen holes which is reckoned as a player's score, the player taking the least number of strokes winning.



Goldsmith, poet and playwright



Death of Gordon in Khartoum during the revolt led by the Mahdi

Clock golf is a game of putting, which can be played on any lawn. Metal numbers, one to twelve, are placed at regular intervals on the circumference of a large circle around a hole at or near the centre, which is made by inserting a tin or flower pot flush with the ground. The ball is then placed beside each number in turn, and putted into the hole, the player needing the fewest strokes winning.

GOODWILL is the value of a firm's name, reputation, and connections. A business with a long tradition of good service will value its goodwill highly. Its name will be its best advertisement. If such a business is bought, the buyer will have to pay for this goodwill.

GOOSE. See **DUCK**.

GORDON, Charles (1833-1885), "Chinese Gordon," was a famous British soldier and administrator.

He took part in the Crimean War (1855). In 1860 he went to China, and led a Chinese army, officered by British and Americans, against some rebels. He recovered Nanking and crushed the rebels.

In 1873 Gordon took an appointment under the Khedive of Egypt, to open up the vast regions of the equatorial Nile, where he tried to bring the slave trade to an end. He was Governor of the Sudan from 1877 to 1880. Four years later Gordon returned to the Sudan where a revolt had broken out among the desert tribes, led by a wild prophet known as the Mahdi. Gordon reached Khartoum, where he was surrounded and besieged. Five months later a relief force was sent out from England, but the navigation of the Nile was difficult and dangerous, and two days before the force reached Khartoum, the

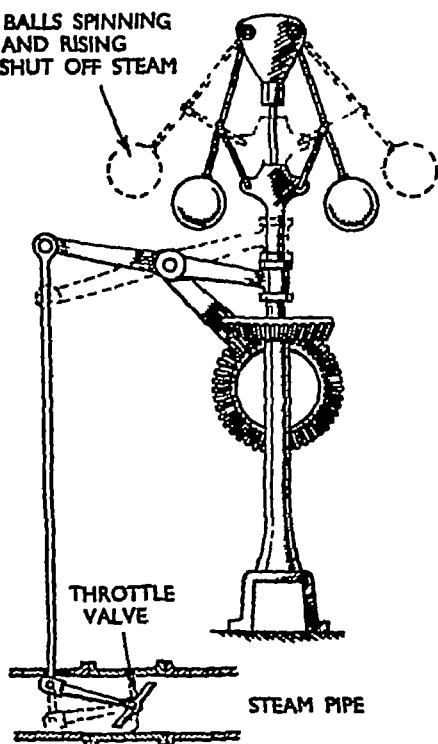
city had been captured by the rebels, and Gordon put to death (1885)

GORGONS in CLASSICAL MYTHOLOGY are three terrible female monsters with serpents on their heads instead of hair, who turned all they looked upon into stone. One of them, Medusa, was slain by the Greek hero PERSEUS.

GOSPEL means "good news." The followers of Christ started to tell the news of how Christ came to save all men, so the first four books of the NEW TESTAMENT are called the Gospels.

GOVERNOR. When a motor car comes to a hill and the load on the engine gets greater, the driver pushes the accelerator to give the engine more petrol and power, thus maintaining the speed. In big engines, in which an alteration of speed may be undesirable or even dangerous, the increase or decrease in power necessary to maintain even

BALLS SPINNING
AND RISING
SHUT OFF STEAM



Governor keeping the speed even

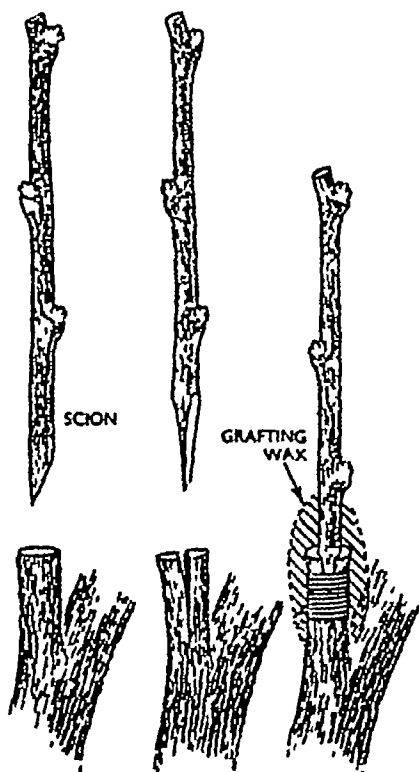
speed is controlled by means of an automatic governor. This device operates so that any drop in speed allows the engine more steam or petrol, and any increase in speed cuts it down.

A simple governor is shown in the illustration as the speed increases the governor balls, driven by the spindle from the main shaft of the engine, spin further outwards and upwards. A collar which slides on the spindle also rises. This causes a rod to be pushed down, and as this rod operates a throttle valve in the steam pipe, the steam supply to the engine is reduced and the speed thereby slowed down.

GRAFTING is the operation in gardening whereby twigs or shoots of one tree are fixed to another tree in order to propagate better varieties of fruit quickly. The twig (of apple or pear, etc.) to be grafted on is called a scion, the tree on to which it is to be grafted is known as a stock. Grafting is usually carried out in March when the sap is beginning to rise. A notch is cut in the stock and the scion is shaped to fit neatly into it, the two are then joined together and secured in position with raffia. The exposed surfaces are sealed with a covering of grafting wax to keep out air, and to prevent any possible disease attacking the joint. This is cleft grafting, other methods are whip and tongue grafting and crown grafting. See BUDDING.

GRAMMAR deals with the work that words do when they are used in a sentence, the changes they undergo to show change of meaning, and their proper arrangement.

The *sentence* (see SYNTAX) is the foundation of all speech and writing. It is a group of words which makes complete sense, such as a statement, a question, a wish or an exclamation.



Steps in cleft grafting

tion Sometimes part of the sentence may be understood to be there, even if not actually expressed For example, if asked, "Will you come out?" you might reply, "Yes" Your reply is grammatically incomplete, but your meaning, "Yes, I will come out," is understood

A *phrase* differs from a sentence in not making complete sense Just to say "in half an hour"—a phrase—would not, by itself, convey full sense

Analysis There are two parts in a sentence the *subject*, the word or words which name what is spoken about, and the *predicate*, which tells you what is said about the subject The subject usually comes first, but not always If you say, "The cow jumped over the moon"

subject "the cow," predicate "jumped over the moon" This could be written, "Over the moon the cow jumped," but "the cow" would still be the subject This breaking up of a sentence into its different parts is called *analysis* In a detailed analysis, subject and predicate are further sub-divided

Parts of speech The words forming a sentence do different kinds of work They are grouped into parts of speech according to the work they do, but as the same word may do different things in English, it is impossible to decide what part of speech it is until it has been studied in a sentence

There are eight parts of speech in English noun, adjective, pronoun, verb, adverb, preposition, conjunction, and interjection

(1) A *noun* is the name of anything For example The *bird* sang Mary was dancing *Life* is sweet

(2) An *adjective* limits, or makes more exact, the meaning of a noun For example I have a *new* bicycle *Many* hands make *light* work

(3) A *pronoun* is a word used instead of a noun For example, instead of The customer gave the cashier a shilling, you could have *She* gave *him* a shilling

(4) A *verb* asserts or states something, and unless a sentence includes a verb it is not possible for a speaker to be clearly understood Therefore it is the most important of all the parts of speech For example The aeroplane flew across the sky The verb *flew* tells what the aeroplane did

If the verb shows that an action is confined to the doer of the action, and does not affect anything else, then the verb is *intransitive* For example The cat jumped If the verb shows an action as affecting something or somebody else, then the verb is *transitive* For example

The cat *scratched* the dog Here the action of scratching affects the dog The person or thing affected by the action is the object of the transitive verb: in the example *dog* is the object of *scratched* A person or thing may be indirectly affected by an action, and becomes the *indirect object* of the verb I gave him the book. The transitive verb "give" has two objects, *him* (indirect) and *book* (direct)

A verb may also show by its form the time of an action and its completeness or otherwise This form of the verb is called its *tense*

The four divisions of time, the present, the past, the future and the future in the past, are each represented by a *simple*, a *continuous*, a *perfect* and a *perfect continuous* form, e.g

Simple

Present: I write

Past: I wrote

Future: I shall write

Future in the Past I should write

Continuous

Present: I am writing

Past I was writing

Future: I shall be writing.

Future in the Past I should be writing

Perfect

Present. I have written.

Past: I had written

Future: I shall have written

Future in the Past I should have written.

Perfect Continuous

Present I have been writing

Past: I had been writing.

Future I shall have been writing

Future in the Past I should have been writing

It will be seen that more than one verb may be necessary to make a tense When part of another verb is used, especially of the verbs *to be* and *to have*, it is called an auxiliary or helping verb. The auxiliary is

used with a special part of the other verb in the example *writing* and *written* These parts are called *present* and *past participles*

When the subject of the sentence is the doer of the action shown by the verb, the verb is in the *active voice*. When the subject has the action done to it, the verb is in the *passive voice* These two examples show the difference: The hunter *killed* the lion. The *hunter* (the subject of the sentence) is the doer of the action, so the verb *killed* is *active voice* The lion *was killed* by the hunter The *lion* (the subject) has the action done to it, so the verb is *passive voice*.

The *mood* of a verb is its special form showing the manner of an action If a verb just makes a statement of fact it is in the *indicative mood* If it indicates a request or command, it is in the *imperative mood* The *subjunctive mood*, showing doubt or indecision, is rarely used in English now It appears in such sentences as this. If he *were mistaken*, it would be very serious But gradually such subjunctives are dying out of use and being replaced by indicatives The *infinitive mood* (e.g. *to write*) is used without limitation of number or person, as a noun, as an interjection, or to complete the sense of an adjective or other verb

This is a great deal to say about one part of speech, but the verb is the most important of all

(5) An *adverb* does for the verb, the adjective, or another adverb very much what an adjective does for a noun—modifies, or makes more precise, the meaning of the word. It may tell you how the action of a verb was done, or where, or when For example. The dog barked *savagely*, I am coming *now*

(6) If a noun or pronoun is neither the subject nor the direct

object of a verb, it normally has a *preposition* before it to show the relation of that word to the rest of the sentence For example The postman calls *in* the morning We are all waiting *for* you

(7) A *conjunction* joins together nouns, sentences or clauses For example The traveller ran all the way to the station, *but* he missed the train

(8) An *interjection*, a word such as *ah*, *oh*, *hurrah*, etc., shows some strong feeling, but unlike the other parts of speech, it does not form a necessary grammatical part of the sentence, that is, the sentence could still be understood without it

The *articles*, *a*, *an*, *the*, are really adjectives the first two are the indefinite article, the last the definite article

Parsing Parts of speech may be *parsed*, that is, full details may be given of a word in a sentence, what part of speech it is, what it does, and what its relation is to the rest of the sentence In order to parse some parts of speech it is necessary to know certain grammatical terms

Nouns and pronouns may represent one person or thing, or several If the word refers to one thing only, then it is in the *singular* number, as *book*, *child*, *I*, *she* If it refers to more than one thing, the noun or pronoun is in the *plural* number as *books*, *children*, *we*, *they*

Nouns and pronouns may also be grouped according to the sex of the objects they represent This is called their *gender* When they represent something male, they are in the *masculine* gender e.g. *man*, *brother*, *he* when something female, they are *feminine* e.g. *woman*, *sister*, *she*, when either male or female, they are in the *common* gender, e.g. *friend*, *they*, when neither male nor female, they are in the *neuter* gender, e.g. *house*, *road*

First person pronouns refer to the person speaking *I*, *we*, *us*, *me*, second person, to the person addressed *you*, third person, to the person spoken about *he*, *they*, *them*, *him*, *she*, *her*, *it*

Adjectives and adverbs may be compared, and show what degree of some quality is possessed The different forms they take in showing this are called the *degrees of comparison* There are three the *positive*—as Joan is *tall* the *comparative*, involving two persons or things—as Joan is *taller* than Mary the *superlative*, comparing more than two—Tom is the *tallest* of the whole family When adjectives are long words, for convenience the degrees of comparison are shown by using *more* and *most*, as *beautiful*, *more beautiful*, *most beautiful*

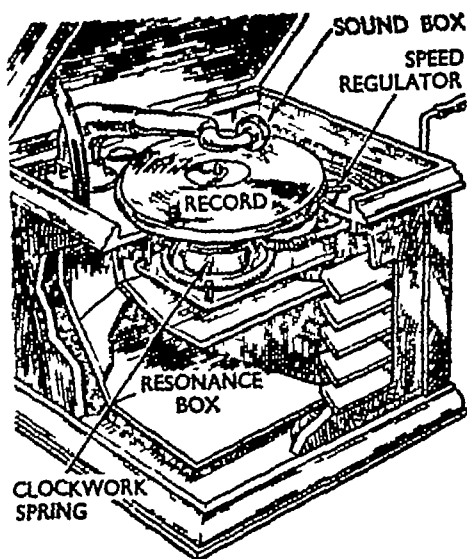
Case in grammar is the special form of a noun or pronoun showing its relationship to other words in the sentence In English there are very few case forms left They appear in the 's or s' showing possession, e.g. *John's* cap the *babies'* toys

GRAMOPHONE There are two parts of a gramophone, which we will consider separately—the record and the machine

The record is a disk made from shellac and waxy materials and bearing on each face a spiral groove The groove wavers to and fro about its centre line in accordance with the sound vibrations recorded on it

The machine contains firstly a motor to turn the record at a uniform speed, and secondly a sound box or reproducer to reproduce the sounds recorded on the record

The motor may be spring or electric-driven In either case the speed has to be kept very steady usually at seventy-eight revolutions per minute, otherwise the **PITCH** of



Inside the gramophone

the notes reproduced would be incorrect

The single sound box has a needle which vibrates in the groove as the record is rotated by the machine. As the needle is attached to a DIAPHRAGM, the vibrations of the needle become vibrations of the diaphragm. These can be heard as sounds, which are made louder in the resonance box.

Some gramophones are now combined with a wireless set, the needle turning the vibrations it receives from the groove into electric impulses which are changed into sound in the LOUDSPEAKER. Such a combination is called a radio-gram. See also DICTAPHONE.

GRAPHS. In a graph we show quantities by position, so that we can see at a glance how they change. Here is a simple graph which represents the monthly sales at a shop. We draw two lines at right angles. Along the bottom line we set off equal distances for the months. Along the upright lines the equal distances stand for hundreds of pounds' worth of goods sold. January sales are £250, we go

up to 250 on the January line and mark that point. In the same way we mark the sales for other months. We join the dots by lines to make them stand out much more clearly. The graph now tells the sale in any month. June, for example, was £650. It also shows how sales rise toward the middle of the year, and then fall, with a sudden increase at Christmas.

Graphs of this kind can be used to show the weekly production of goods in a factory, weekly, monthly, or yearly expenditure, the monthly rainfall in a country, hours of sunshine per week, and indeed almost anything that varies from hour to hour, from day to day, or over longer periods. Some instruments draw their own graphs, the up-and-down movements of thermometer or BAROMETER are sometimes communicated to a pencil which records the graph on a revolving cylinder, thus giving a permanent record of the changes in heat and pressure of the atmosphere.

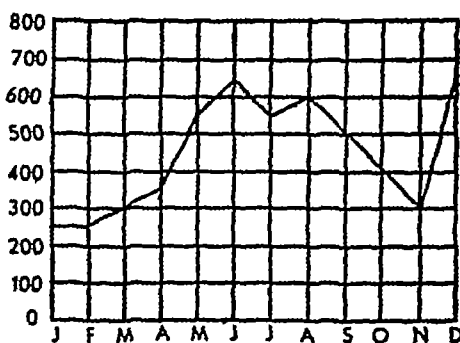
Graphs can also be used to solve EQUATIONS, especially quadratics. To solve $4x^2 + 1 = 4x + 7$. We take all the terms over to the left

$$4x^2 - 4x - 3 = 0$$

We write y for the expression (or function) $4x^2 - 4x - 3$

$$y = 4x^2 - 4x - 3$$

We give x various values (-3 , -2 , -1 , 0 , 1 , 2 , 3 , etc) and find

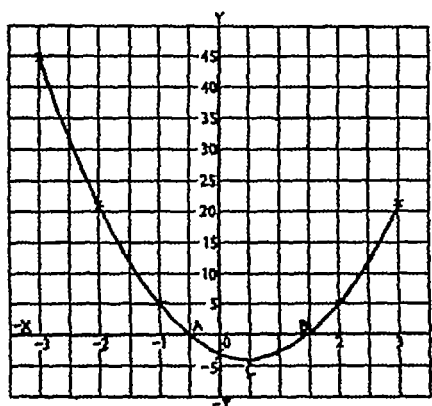


Graph showing monthly sales

the corresponding values of y . Here is a convenient way of setting it down

x	-3	-2	-1	0	1	2	3
$4x^2$	36	16	4	0	4	16	36
$-4x$	12	8	4	0	-4	-8	-12
-3	-3	-3	-3	-3	-3	-3	-3
y	45	21	5	-3	-3	5	21

We take suitable scales for x and y . For x we only need to show from -3 to +3, for y we want as much as 45. We take the points in turn



Graph of a quadratic equation

$x = -3$, $y = 45$, go back 3 from 0, and up 45, and mark this point, $x = -2$, $y = 21$, go back 2 and up 21. Then back 1 up 5, down 3 from 0, forward 1 down 3, forward 2 up 5, forward 3 up 21.

We join the points with a smooth curve, and so get the graph. We want the points where $y = 4x^2 - 4x - 3 = 0$. These are A and B, where $x = -\frac{1}{2}$ and $+\frac{3}{2}$. These are the solutions of the equation.

The graph also shows that the lowest possible value of $4x^2 - 4x - 3$ is at C, this value is -4, and for this value $x = \frac{1}{2}$.

This is a useful method of showing equations relating to dynamics, etc. See also CO-ORDINATE GEOMETRY.

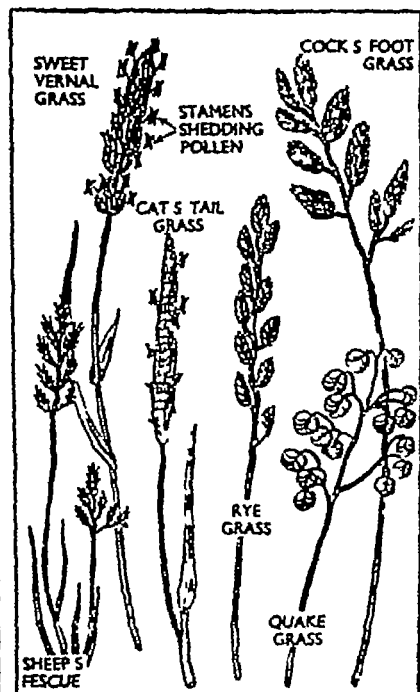
GRASS. The grasses are a family of flowering plants from which

come bread and all CEREAL foods. Pasture for sheep and cattle is grassland. Grass is sown from seed or laid from field turf. Grasses are ANNUAL or PERENNIAL, and are wind-pollinated. See POLLINATION.

GRASSHOPPER. See COCK-ROACH.

GRAVITY. All bodies—such as this book in your hand—have weight, that is, they are attracted towards the centre of the earth. We do not know what causes this force which pulls things towards the ground and so gives them what we call weight, but we do know that every piece of substance, from the smallest grain of powder to the largest star, exerts some attraction on every other piece. See also EQUILIBRIUM, and SPECIFIC GRAVITY.

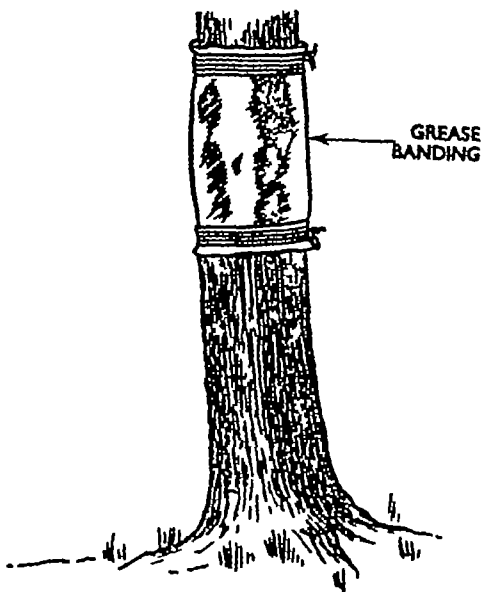
GRAY, Thomas (1716-1771), a quiet but distinguished poet who became Professor of History and Modern Languages at Cambridge,



Some common meadow grasses

and wrote what is perhaps the best-known poem in English literature, the "Elegy in a Country Churchyard"—in which there is love of nature, love of England and a quietly democratic spirit His slyly humorous poem, the "Ode on the Death of a Favourite Cat," is almost a parody of his own style

GREASE BANDING is a method of preventing the female winter moth, which has no wings, from climbing fruit trees Greaseproof paper is carefully wrapped round the tree and securely tied at the top and bottom to prevent moths crawling underneath it. The paper is then smeared with a special sticky substance manufactured for the purpose. All grease banding should be



Grease banding neatly done

completed by the second week in October, and repeated in the spring See also **INSECT PESTS**.

GREAT BRITAIN, the largest of the **BRITISH ISLES**, comprises **ENGLAND**, **SCOTLAND** and **WALES** These three together with **NORTHERN IRELAND** constitute the United Kingdom of Great Britain and Northern Ireland

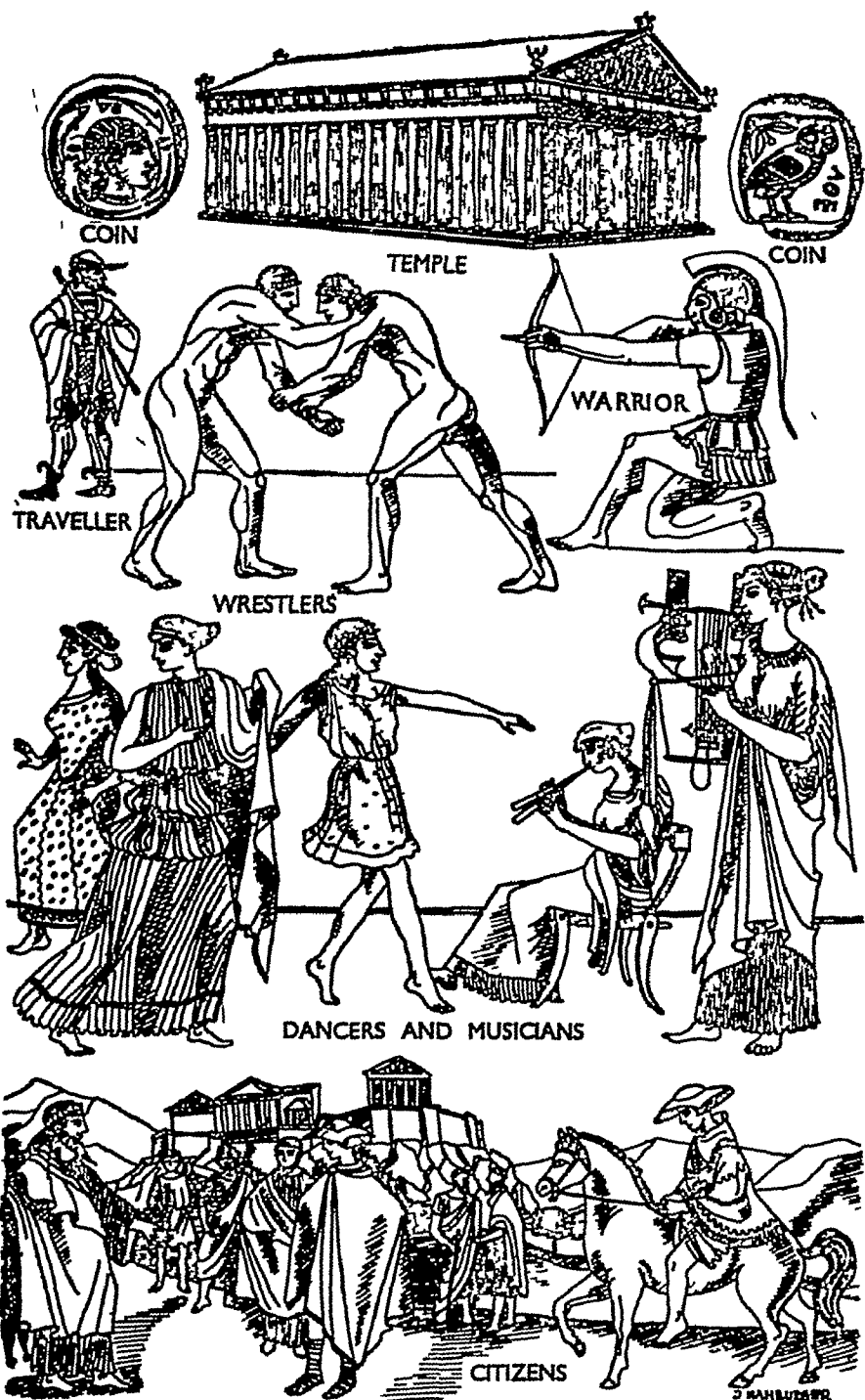
GREATEST COMMON MEASURE. See **FACTORS**.

GREECE is a country comprising most of the peninsula around the Pindus mountains, a strip along the northern Aegean coast and many small islands in the Aegean, the largest of which is the mountainous island of Crete Only about a fifth of the country is cultivated, but currants, other fruit and "Turkish" tobacco are noted exports. The capital, Athens, with its magnificent ruins of ancient Greek civilization, attracts many tourists See **GREEKS** and map of the **BALKAN PENINSULA**.

GREEK ORTHODOX CHURCH. There are a number of Christian Churches in the Near East, the chief one being that which grew up in the early Christian centre at Constantinople, which do not admit the authority of the Church of Rome. This main one, the Greek Orthodox Church, is strongest in Greece, the U.S.S.R., the Balkans and the Near East Its head is the Patriarch of Constantinople.

GREEKS, the most wonderful people of the **ANCIENT WORLD** They lived on the mainland of Greece, on the coasts of Asia Minor, along the Aegean Sea and on its many islands

They set up colonies on other parts of the Mediterranean shores, including Massilia (Marseilles) The Greeks loved beautiful things—buildings, statues, pottery; the temples to their gods are still among the finest examples of architecture They also loved poetry, drama, dancing and music, and their dramatists and philosophers (Aristotle, Plato, etc) are famous to this day. Old Greek stories written three thousand years ago are read today Some of them tell of the ten years' siege of Troy,



The Greeks loved art and sport and were great builders

and of the wanderings of Ulysses, one of the heroes of the Trojan war See CLASSICAL MYTHOLOGY

The Greeks lived in about 150 free city-states, the best known of which were Athens, Sparta, Corinth and Thebes But, although these cities were often at war with each other, every fourth year there was a "sacred truce" between them, so that their athletic youths might attend the games at Olympia, where there were contests in running, jumping, wrestling, throwing the discus and casting the javelin The victors were crowned with a wreath of wild olive leaves

The Greeks found out many things about the earth, the sun, moon and stars They learned about their own bodies, and knew how to cure many diseases Many words we use today in science, geography, history and medicine have come down to us from the Greeks They also tried to find out the best way to govern their cities, and the word "politics" which we use when

speaking about government, comes from the Greek word *polis*, the city-state Like the rest of the ancient world, they kept slaves to work for them About 335 B C Alexander, young king of Macedonia, conquered the Greek cities, but he admired all things Greek, and as he conquered other countries in Asia he had the people taught the Greek language, Greek arts, and the Greek ways of living At

the beginning of the Christian era, many people in south-east Europe and south-west Asia could speak Greek This greatly helped the work of early Christian missionaries, such as St Paul The New Testament itself was first written in Greek

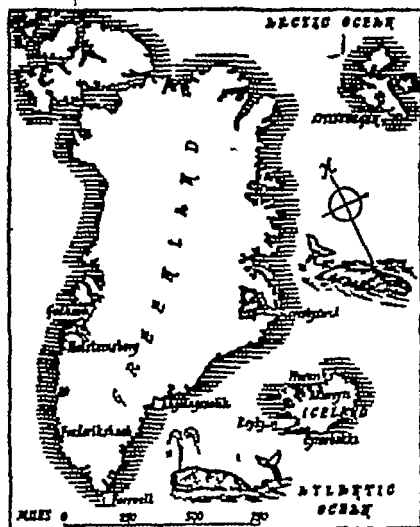
GREENHOUSE, a building largely of glass and artificially warmed in which the gardener can grow plants out of their proper season, bring young plants along quickly, and grow those plants which are natives of warmer countries The greenhouse should be kept free of dirt and dust, if the floor is of concrete it can be swilled down with water easily and regularly Plants are kept in pots and boxes on the shelves and staging, which should be made of slatted wood so that the air can circulate freely Windows at the top and sides should be made to open to give good ventilation and to allow the temperature to be controlled during the summer months Green-



This Eskimo boy lives in Greenland

houses can be heated in winter by (1) an oil stove, (2) a hot-water pipe from a coke boiler, or (3) by electricity See **HARDENING OFF**

GREENLAND, a large island off Canada, is Danish territory Nearly all the country is covered by ice sheets, the remains of the Ice Age



Map of Greenland and Iceland

The inhabitants, mostly Eskimos, live in scattered settlements along the coast

GREEN MANURING is a method of enriching the soil by planting vetches (relatives of the broad bean, often grown for fodder) and mustard seed after an early crop has been lifted, and during the following winter (when they are fully grown) ploughing or digging them into the ground where they will rot and so act as **FERTILIZERS**

See **MANURING**

GRID is the usual name for the power cables of the British grid system of electric power distribution

In **WIRELESS**, a grid is a control electrode in a wireless **VALVE** It is usually in the form of a wire mesh

GRIEG, Edvard Hagerup (1843-1907), was a Norwegian poetic musician and composer who drew the attention of the whole world to the folk-music of Norway

GRINDSTONE, commonly a thick disk of stone or other abrasive material, the disk being mounted on a strong shaft and driven round at a high speed, either by foot or motor Grindstones are used for sharpening tools, such as chisels

GUADELOUPE. See **MARTINIQUE AND GUADELOUPE**

GUATEMALA, a small republic of Central America Over half the population are Indians The capital is Guatemala Its principal export is coffee See map of **CENTRAL AMERICA**

GUIANAS, two South American colonies, British and Dutch, and French Guiana, an overseas part of France, mostly dense forest In the coastal regions sugar, rum and rice are produced, mostly in the British colony Some gold, diamonds and bauxite (an aluminium-bearing ore) are mined, and balata, a rubber substitute, is found British Guiana is the largest and most developed of the three countries, and contains the Kaieteur waterfalls, the highest in the world The former penal settlement of Devil's Island is off the coast of French Guiana The capitals are Georgetown (British), Paramaribo (Dutch) and Cayenne (French) See the map of **SOUTH AMERICA**

GUILDS, in the **MIDDLE AGES**, were associations of traders and craftsmen They were of great importance in the development of commerce and industry and a sense of community (living together)

The oldest form of guild was the merchant guild, or "guild merchant" as it was called, which guarded the interests of traders, saw that business at the fairs was



London's Guildhall in 18th century

carried on in an honest manner, helped merchants to collect debts, and gave assistance to any who suffered loss by shipwreck, etc. The craft guilds looked after people engaged in a certain craft or industry, saw that good work was produced, that apprentices were thoroughly taught, so that good workmen could carry on the craft, and that the rules of the trade were observed. In most medieval towns no trader or craftsman who was not a member of a guild was allowed to carry on business.

The guilds helped sick or aged members, and widows and orphans of deceased members. They did the work of friendly societies and insurance companies of today, and also often paid for new roads and bridges, and endowed schools and chapels or churches. Many old towns and cities still have the

Guildhall in which the guilds held their meetings.

GUINEA-PIG. See **RODENT**

GUINEA-PIG AS A PET. The treatment of a guinea-pig is identical with that of a rabbit. It should be given rather more greenstuff than corn, but of course in smaller quantities than for rabbits—and don't forget a plentiful water supply. See **RABBIT AS A PET.**

GUITAR, a "plucked" stringed instrument mainly associated with Spain. It has usually six strings, and is bigger and more important musically than the ukulele, which has four strings. Of the same family are the **LUTE**, the **MANDOLINE** and the **BANJO**. The modern Hawaiian guitar is played with a steel plectrum, which results in a sharper sound. See page 404.

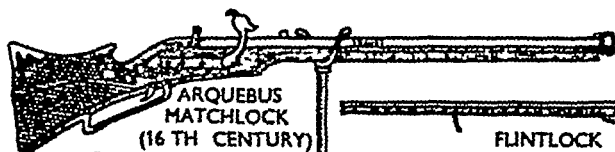
GULF STREAM, a warm ocean current flowing from the Gulf of Mexico towards the coasts of north-west Europe, whose seas it keeps free from ice. See map of **OCEAN CURRENTS**.

GUM is a weak adhesive, usually with a starchy basis.

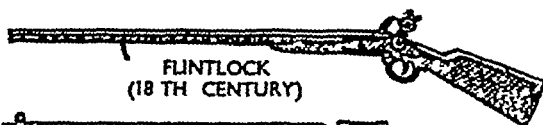
GUN. In the 14th century gunpowder was discovered, and its explosive power used to hurl lumps of stone and iron from guns made of wood, leather, brass, bronze and iron. Such guns, though of limited range, were very effective against troops and light fortifications, and at sea against the wooden masts and sides of ships. In the 16th century the light gun carried by men, the arquebus, was still so heavy that it often had to be rested on a support to be fired. Both cannon and arquebus were loaded through the muzzle, and discharged by a lighted slow match applied to the priming powder. The arquebus was replaced by the flintlock, in which the priming powder was fired by sparks from a flint struck



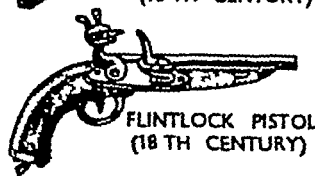
HAND CANNON (14 TH CENTURY)



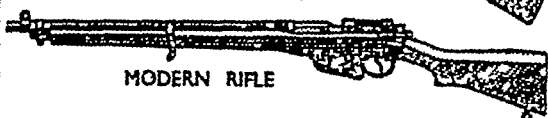
ARQUEBUS
MATCHLOCK
(16 TH CENTURY)



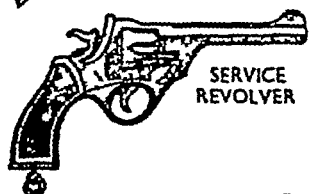
FLINTLOCK
(18 TH CENTURY)



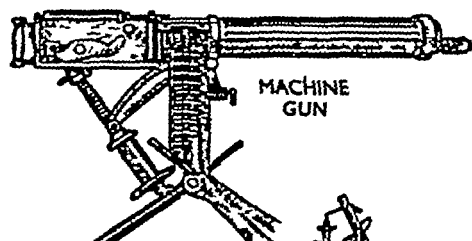
FLINTLOCK PISTOL
(18 TH CENTURY)



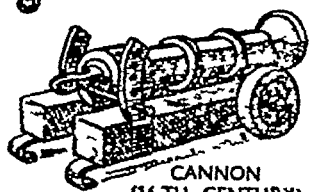
MODERN RIFLE



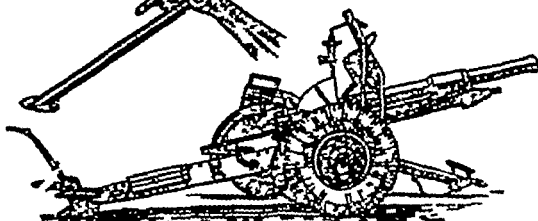
SERVICE
REVOLVER



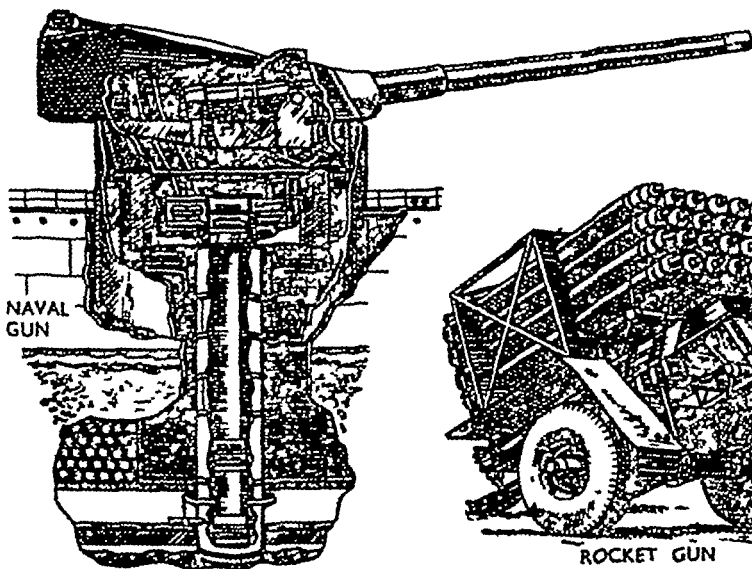
MACHINE
GUN



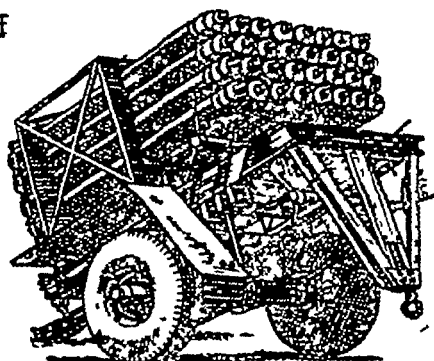
CANNON
(16 TH CENTURY)



FIELD GUN



NAVAL
GUN



ROCKET GUN

From the simple hand cannon of the 14th century have developed the highly complicated guns and firearms of the present day



The arrest of Guy Fawkes exposed the Gunpowder Plot

against a piece of steel. Then came the explosive cap, which when struck by a hammer set off the powder. Later still the breech-loading gun was invented, with its cartridge containing bullet, powder and cap in one unit.

With better explosives, bullets went farther, but then it was found that the round bullet did not travel true, and so the cylindrical bullet was introduced. This was given a twist as it was driven out along the gun barrel by means of the rifling or spiral groove cut on the inside of the barrel, so the modern "rifle" was invented.

Automatic weapons were next developed, in which the ejection of the spent cartridge case and the reloading and firing of the next round could be carried out by a mechanism, which operated either from the recoil of the gun or from the pressure of the exhaust gases in the barrel. This process continues so long as the trigger is depressed and

the ammunition lasts, as in the machine gun.

Smooth bored firearms throwing a charge of lead shot are still used for sporting purposes, as they enable the marksman to hit a flying bird or running rabbit without the extreme accuracy of aim which would be needed if a single rifle bullet were fired.

In artillery, the muzzle-loading cannon with its round cannon ball gradually disappeared, superseded by breech-loading guns with longer barrels, rifled inside, and firing shells capable of punching their way through armour plate to explode inside their target. The range, too, increased, with no loss of accuracy.

In the modern rocket, instead of the shell being hurled forward by one terrific explosion inside the gun barrel, there is a continuous explosion from the back of the rocket shell itself as it rushes through the air. Hence the rocket

gun does not need a thick-walled barrel to withstand the shock of an explosion, but consists merely of guide rails or a thin-walled tube to direct the rocket shell on its right course. Rockets are usually fired in salvos.

GUNMETAL is a bronze alloy 88 per cent copper, 10 per cent tin, 2 per cent zinc, so named because it gave strong castings for making muzzle-loading cannon. It is not corroded by damp.

GUNPOWDER PLOT (1605), an attempt on the part of a few Roman Catholics to blow up the Houses of Parliament in the days when Puritanism was growing in England. The conspirators were joined by Guy Fawkes who had served with Spanish troops on the Continent and was experienced in the art of mining and the use of explosives.

Gunpowder was stored in a cellar under Parliament House, and all was ready to carry out the plan on 5th November, when King James I would open Parliament. But the secret leaked out, a search was made, and Guy Fawkes was found waiting to light a trail of gunpowder. He was arrested. The arrests of other plotters followed, and they were put to death. For over three centuries, the 5th November has been celebrated with bonfires and fireworks, and the burning in effigy of Guy Fawkes.

GUTTA-PERCHA is a rubber-like material obtained from the sap of certain trees. It has the useful property of softening when warmed and is used also as an electrical insulator.

GYMNASTICS, exercise of the body to promote health and strength by means of apparatus. A typical gymnasium includes climbing ropes, vaulting horses, a trapeze, overhead beams, wall-bars,

a horizontal ladder, parallel-bars, rings and so on.

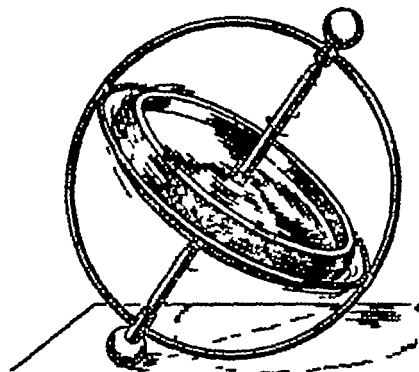
GYPSY, one of a dark-skinned, wandering race that is found all over Europe. Their customs and language are of Hindu origin. They live by horse-dealing, fortune-telling, basket-making, fruit-picking, and other odd jobs.

GYROSCOPE (compass, pilot and stabilizer). A gyroscope is a rapidly spinning wheel which tends to keep its axle, i.e. its axis, pointing in the same direction, and resists any attempt to alter that direction.

It is used therefore instead of a magnet in a gyro-compass to give a fixed direction whereby the pilot of an aeroplane or ship can judge the direction in which he is travelling.

A gyroscope can also be used to steer a vessel on a given course by connecting it with the controls, so that, if the vessel is turned off its course, the gyroscope will alter the controls so as to bring it back on to its original course. Gyro pilots of this type were used to control the flight of flying bombs.

In the same way, a large gyroscope placed in the bottom of a ship can be made to stabilize the ship and reduce the effect of the waves upon it.



Gyroscope spinning on the slant

HABEAS CORPUS is the name given to the writ issued to the official in charge of a person detained, directing him to bring the person before a judge or court so that the lawfulness of the detention may be investigated. This ensures that no one in England can be held in prison long without trial. A similar writ is mentioned in Magna Carta. See also **CHARLES II**.

HABSBURGS, the former royal family of **AUSTRIA**. They took their name from a castle in Switzerland, which was the home of the family in the 12th century—Habsburg, meaning "Hawk's Castle."

HADES in **CLASSICAL MYTHOLOGY** is the nether or lower world, the abode of the spirits of the dead, ruled by **PLUTO**.

HAITI and **THE DOMINICAN REPUBLIC**, the western and eastern halves of the island of

Haiti in the **WEST INDIES**, were formerly colonies of France and Spain respectively. They are now Negro republics. The island is largely highland, rising to mountain, and the chief trade, not very highly developed, is in cocoa, coffee, sugar and timber. The capitals are Port-au-Prince (Haiti), Ciudad Trujillo (Dominican Republic).

See map of **CENTRAL AMERICA**.

HANDEL, George Frederick (1685-1759), was born in Germany. He achieved fame as a composer of **OPERA** and was appointed court musician to the Elector of Hanover. In 1712 Handel came to England and stayed there. He soon achieved popularity, but it was very awkward for him when the Elector of Hanover came to England as George I. However, the king forgave him, and he wrote his well-known "Water Music" for one of the royal water parties on the Thames. He entered the service of the Duke of Chandos, but later turned his attention to the writing and production of operas. When this venture failed financially, he wrote **ORATORIOS**, of which the most famous is *The Messiah*. He went blind in 1752.

His other works include some pieces for the organ and the harpsichord (forerunner of the piano) together with orchestral and **CHAMBER MUSIC**.

HANSARD, the name given to the Government publication of the official reports of the proceedings in Parliament. The name was taken from Luke Hansard who first printed the reports in 1774.

HANSEATIC LEAGUE, or the Hansa, a league of merchants in the Middle Ages belonging to the free imperial cities of north Germany—



Handel found fame in England

Cologne, Hamburg, Bremen, Lübeck and Danzig

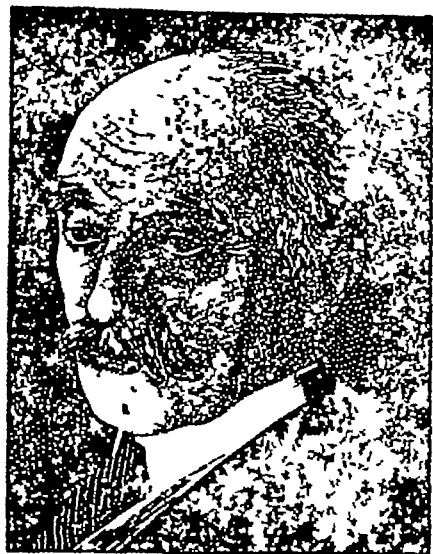
They controlled all the trade of Germany with England, with the Scandinavian countries, and with Russia. The trade with the Baltic was chiefly in herrings (for use on fast days), and timber for ship-building. The trade with Russia was mainly in furs.

The league had a trading post in England as early as the reign of Henry II, later they built a warehouse in London, known as the Steelyard. They also had houses at Boston (Lincolnshire) and King's Lynn. The Steelyard was planned like a fortress, and the merchants lived after the fashion of a garrison. The Hansa merchants in England were known as *Easterlings*, they were given special privileges for trade by the kings of England, who very often borrowed money from them.

Later, English merchants began to form *GUILDS* to compete with the foreigners, and the privileges granted to the Steelyard came to an end in the reign of Queen Elizabeth. A disastrous war with Scandinavia broke the power of the league, and in the 17th century it was finally dissolved.

HARDENING OFF is the process which accustoms plants grown in the *GREENHOUSE* to the colder temperature of the outer air, and consists in placing them in a *COLD FRAME* at first and later in a sheltered position in the garden. If plants are made to suffer a very sudden change of temperature their growth will be affected and they might even die.

HARDY, Thomas (1840-1928), was born near Dorchester, in the district which figures in all his novels as *Wessex*. He first made his reputation as a novelist, and between 1871 and 1896 he wrote some twenty works of fiction in which



Thomas Hardy, poet and novelist

are many memorable men and women, with simplicity of mind, strong in their feelings, humble in origin and English to the core. His books are rich in life, and his feeling for nature is profound. But most of all do his novels present a distinctive view of life—a deeply felt and tragic view—the struggle of men against a force, blind perhaps, or just ironically indifferent to their sufferings, which Hardy feels to rule the world.

In 1898 Hardy's first volume of poems, *Wessex Poems*, appeared, and his work for the rest of his life was poetry, which although mainly lyric is often touched with his comprehensive sense of the ironic and the tragic. *The Dynasts*, however, is different in being an epic-length drama in verse on the Napoleonic wars. His best novels are *The Return of the Native*, *The Trumpet-Major*, *The Mayor of Casterbridge*, *Tess of the D'Urbervilles* and *Jude the Obscure*. His poems are obtainable as *Collected Poems*.

HARE. See **RABBIT AND HARE**

HARMONICA. See REED INSTRUMENTS

HARMONIUM and AMERICAN ORGAN, musical instruments consisting of sets of reeds made to vibrate by air from bellows operated by the player's feet. The air goes into a reservoir and thence to any reed the passage to which is opened by the player's fingers as they play on the keyboard. Both the harmonium and the American organ have a keyboard like a piano, together with various sets of reeds which are controlled by stops. The difference between the harmonium and the American organ is that in the former the air is blown through the reed while in the latter it is sucked through. The harmonium has a device called the expression stop, which enables the player to cut out the reservoir and send the wind direct from the bellows to the reeds, thus controlling the loudness or softness of the sounds by his feet. The American organ depends for expression on a mechanism which is operated by the knees of the player. Sometimes the wind for the American organ is supplied by an electric motor, and the player's feet are set free to operate a pedal keyboard, which, as in the case of the ORGAN proper, consists of about thirty notes. Such an organ will generally also have two keyboards for the hands (called manuals), and will be found sometimes in churches which cannot afford the space or the money for a pipe organ.

HARMONY, the enriching of a melody by adding other notes, usually of a lower PITCH, which fit in and harmonize with the notes of the melody. These extra notes are often added in clusters to form CHORDS; they do not make melodies of their own, as in COUNTERPOINT.

HAROLD. See WILLIAM I.

HARP, an instrument with many strings, which are plucked by the fingers. The pitch of the strings is altered slightly as required by the use of pedals. See picture on page 404.

HARPSICORD. See KEYBOARD STRINGED INSTRUMENTS

HARVEST-MAN. See SPIDER

HARVEY, William (1578-1657), was physician to Charles I and discovered that blood circulates in the



Harvey, Charles I's physician

body. He deduced, in 1628, from his anatomical study of animals that blood returned to the heart after each passage round the body, and was then pumped on again. This seems commonplace today, but was an outstanding achievement when the current belief was quite different. See CIRCULATION OF THE BLOOD.

HAWAII. See PACIFIC OCEAN

HAWK, a BIRD of prey. Kestrels and sparrowhawks are the commonest British hawks. They swoop on mice and birds seen from high up, clutching them with powerful claws. Kestrels hover while hunting. These and other hawks are trained by falconers. Hawking was a favourite sport in the Middle Ages. See FEUDAL SYSTEM.

HAYDN, Franz Joseph (1732-1809), Austrian composer Son of poor parents, he became a choir boy in the cathedral in Vienna, but, when his voice broke, he took up composing Eventually he became musical director to the famous Hungarian family of Esterhazy, as such, he had ample opportunity for composing all sorts of music—for voices, orchestra, and harpsichord—and then hearing it performed He did much to settle the FORM of the symphony When he was an old man he composed an ORATORIO, *The Creation* Haydn had an important influence on the young MOZART, who learnt from and improved upon Haydn's work and ideas

HAZLITT, William (1778-1830), was a difficult, aggressive man, quarrelsome with his friends, among whom were WORDSWORTH, COLERIDGE, Leigh Hunt and LAMB, unhappy in both his marriages, unfortunate in his ambition—he failed to be a painter Most of his writing is about poets and plays, especially Elizabethan drama We find in all of it a vigour of personality, a clarity and strength of mind and a zest for living which makes him a big man among the lesser writers

Among his most outstanding critical works are *Characters of Shakespeare's Plays*, *The Spirit of the Age*

HEADACHE This may be due to a variety of causes, including eye-strain, movement of a bus or train, lack of fresh air or exercise, constipation, or hunger It may be relieved by lying down with the eyes shut, outdoor exercise, a hot drink, opening medicine, or aspirin, according to its cause Treatment should always aim at removing the cause, and continual headaches need a doctor's advice

HEART. See CIRCULATION OF THE BLOOD

HEAT is one of the forms of ENERGY It is produced chemically by burning FUEL, mechanically by FRICTION, and electrically by passing a CURRENT through a resistance

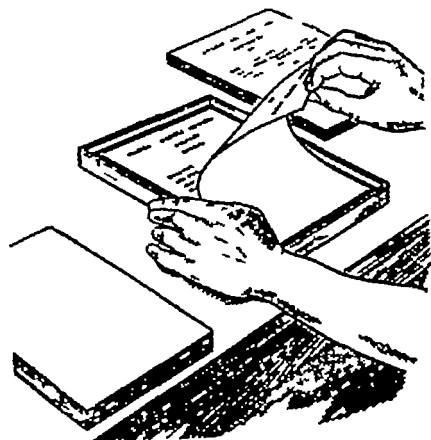
Heat is measured in calories—a calorie is the amount of heat energy required to raise the TEMPERATURE of one gram of water through 1 deg C A fuel is graded by the number of calories one gram of it will give out when burned, and the value of a food is expressed by the number of calories obtained when one gram of the food is burned or digested Engines are devices for turning heat energy into useful mechanical energy

See also LATENT HEAT and THERMOMETER

Heat can be transmitted in three ways—by conduction, by convection, or by radiation See RADIATOR

HEBE See GANYMEDE

ECTOGRAPH, a device for reproducing a number of copies of a document A stiff gelatine slab in an open container is moistened Face downwards on this slab is placed the document, which has been written in a special ink The



Hectograph reproducing copies

ink comes off the paper and sticks to the slab after the paper is removed To obtain a copy of the document, press a clean sheet of paper on to the slab, whereupon some of the ink left by the original comes off on to the clean sheet

HECTOR in CLASSICAL MYTHOLOGY is the eldest son of Priam, King of Troy and chief hero of the Trojans in their fight against the Greeks He was slain by ACHILLES in single combat.

HEDGEHOG AS A PET. If you are lucky enough to find or be given a hedgehog, remember that if you want to keep him well and happy you must give him all the things he would have if he were at liberty

Keep him in a hutch with a run at least 3 feet by 3 feet, very strongly made of fine mesh wire netting It is as well, perhaps, to have the hutch and run built on a stout wooden foundation like a tray about 4 inches deep This can be filled with earth, covered with turf, and an old soup-plate sunk in it and filled with water Make the entrance to the hutch wide enough for him to get through easily and give him plenty of hay and dry leaves for his bed

Hedgehogs **HIBERNATE**, so you will find his appetite increasing as winter approaches and then, when the cold weather comes, he will roll himself in his bed and go to sleep Leave him undisturbed, but keep an eye on the run so that you may be able to offer him a snack should he waken on an unexpectedly mild day

Keep the turf of the run plentifully supplied with worms He likes one occasionally, but prefers beetles, which you must catch alive and give him yourself Woodlice are not very popular, but cockroaches, blackbeetles and the nameless creep-

ing things to be found in odd corners of the garden all help to vary his diet

Give him a small saucer of milk or bread and milk occasionally, and for a special treat, an egg—it need not be a hen's—but crack it for him first. Shredded raw meat, if you can spare it, is also appreciated You might try a dead mouse Experiment and you will soon discover his favourite food

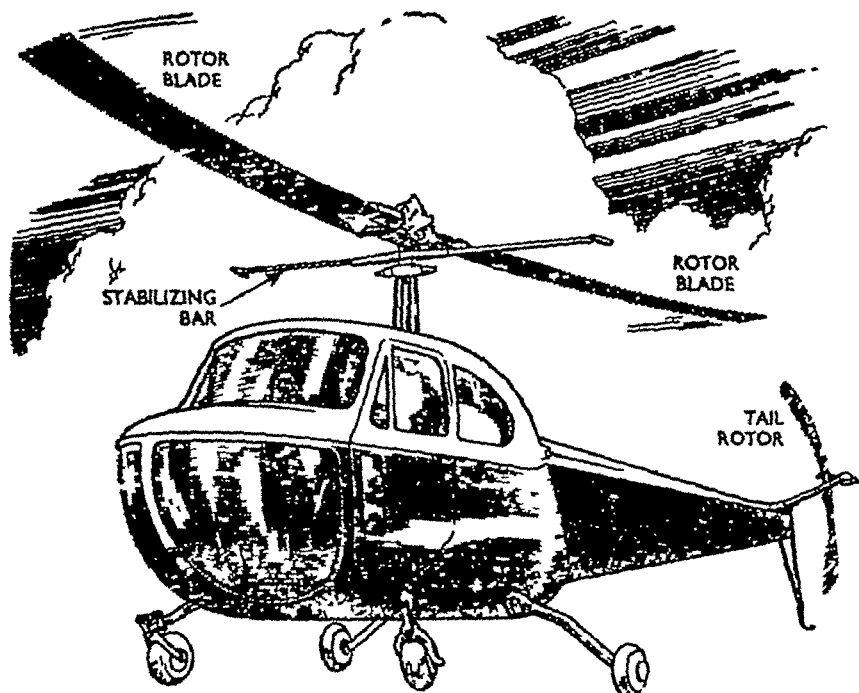
Most hedgehogs have fleas and other parasites, but these do not affect humans It is better not to try to remove them unless they are absolutely swarming, in which case a *very* light dusting of an insect powder should be tried Cedar chips among his bedding will help to keep insects away

Hedgehogs can become very tame and affectionate Let all your movements be gentle, measured and precise You will find he will not mind being handled and will even enjoy having his chest tickled Should he pine, however—and you will soon know whether he is happy or not—it is kinder to let him go See also **INSECT-EATING MAMMALS**

HELEN OF TROY in CLASSICAL MYTHOLOGY was the most beautiful woman of her time. Wife of King Menelaus of Sparta, she eloped with or was carried off by Paris to Troy Thus arose the Trojan War, the chief object of which was to recover Helen On the capture of Troy she was reconciled to Menelaus and returned with him to Sparta

HELICON, a mountain in Greece, was sacred to APOLLO and the MUSES, according to CLASSICAL MYTHOLOGY

HELICOPTER and **AUTOGYRO**. A helicopter is a flying machine which has a propeller rotating horizontally overhead This rotor enables the plane to rise



The helicopter can take off and land vertically and hover in the air

and descend vertically, so that it needs only a small space for taking off and landing. Motion forwards and backwards is obtained by altering the inclination of the rotor blades. To stop the plane from twisting with the rotor, a small propeller or rotor is fitted to the tail. The helicopter can also hover.

An autogyro is like an ordinary aeroplane with a propeller to pull it along through the air, but instead of fixed wings at the side it has a revolving rotor overhead to keep it up in the air. This rotor allows the autogyro to descend almost vertically.

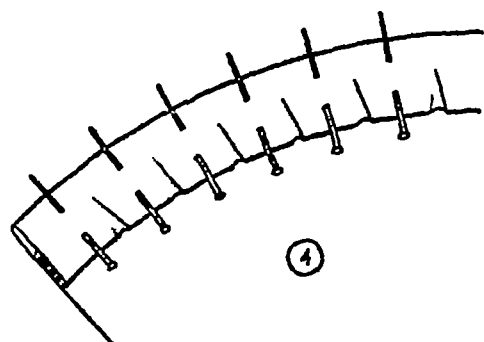
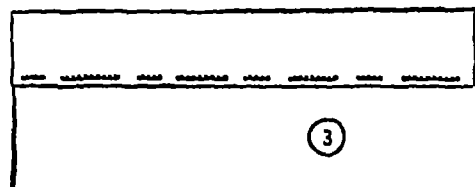
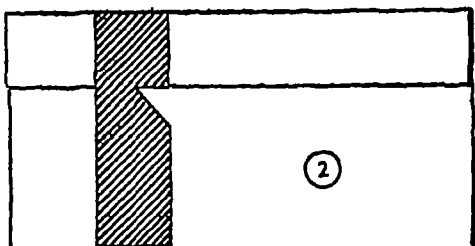
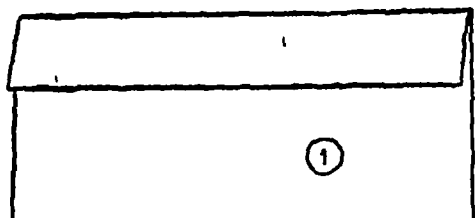
HELIUM is a gaseous ELEMENT of low density and non-inflammable. It forms no compounds. Although scarce, it has been used for BALLOONS and airships, in which it is safer than hydrogen or coal gas because, unlike them, it does not catch fire. Helium was discovered

first not in the earth but in the sun, being observed as an unknown substance in the sun by means of a SPECTROSCOPE. It is obtained from the natural gases associated with PETROLEUM. It is also formed as a result of the breakdown of the element RADIUM.

HELL in the Christian sense means separation from God. Two other words sometimes used for hell are (1) Gehenna (a valley outside Jerusalem) or hated place, used to describe the punishment of the wicked, (2) Hades, the place where all men go to wait for the Last Day.

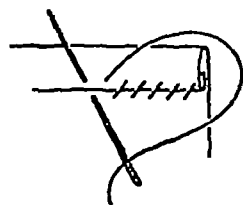
HEM. See **HEMMING**.

HEMMING is a method of securing edges by means of a double fold along the edge on the wrong side of the material. Hems vary in width according to the thickness of the material that we are using. Make the first fold about



Hemming straight or curved edges

$\frac{1}{4}$ inch in width (see 1) Then fold again A notched card (see 2) is useful for keeping hems even, especially wide ones Hold the fold over the first two fingers of the left



Stitching hem

hand. Work from the right to the left Insert the needle in the fold only Draw it out, leaving a short end of cotton under the fold Next, insert the needle in the material just below the fold, then into the edge of the fold Continue to the

end Finish with a BACK STITCH. If the material is thick, tack the hem down before stitching (see 3) Curved hems are difficult to manipulate and should be carefully pinned at 1 inch intervals and the surplus material pressed into tiny pleats (see 4) In transparent materials, the first and second folds of a hem should be of the same width. When a fabric is too thick for a double hem to be turned neatly, the fabric is folded once only, then one edge of bias binding is sewn along the edge of the hem, finally the other edge of the bias binding is sewn on to the body of the material itself, using the same stitch as for hemming The hem can then be pressed quite flat

To find out easily whether the hem of a skirt is level, the measurement should be taken from the ground by means of a ruler, and any alterations necessary marked with pins

HEM STITCHING. Draw out three or four threads a short distance in from the edge of the material Turn in the raw edge and tack a HEM to within a thread of the drawn threads (see 1).

To hem stitch, work from left to right After securing the thread at the left-hand side, slip it from right to left under a group of the threads The number of threads



Steps in hem stitching

taken up by the needle will depend on the thickness of the material, but should remain the same throughout Draw out the thread and insert the needle under the turned-in edge (see 2) Continue in this way until the end of the row.

HENRY I (reigned 1100-1135) was the youngest son of William the Conqueror. He was born in England and married Matilda, daughter of the Scottish King Malcolm and his queen, Margaret, who was a Saxon princess. This made Henry more popular than his brother William Rufus whom he succeeded. He granted a "Charter of Liberties," which became the foundation for the famous Magna Carta. Henry's later years were saddened by the loss of his only son, who was drowned at sea. Henry wished to make his daughter, Maud, his successor, but the barons chose his nephew Stephen.

HENRY II (reigned 1154-1189) was the son of the Count of Anjou and grandson of Henry I. He was only twenty-one years of age when he succeeded his cousin Stephen as King of England, but he was already master of a great part of France.

Henry II was a strong ruler. He set to work to destroy the illegal castles built during Stephen's reign, which had become a danger to peace. He allowed the barons to pay a tax, known as Scutage, or "Shield Money," instead of bringing their sub-tenants to fight for the king. The money enabled him to hire paid soldiers who would be loyal to him.

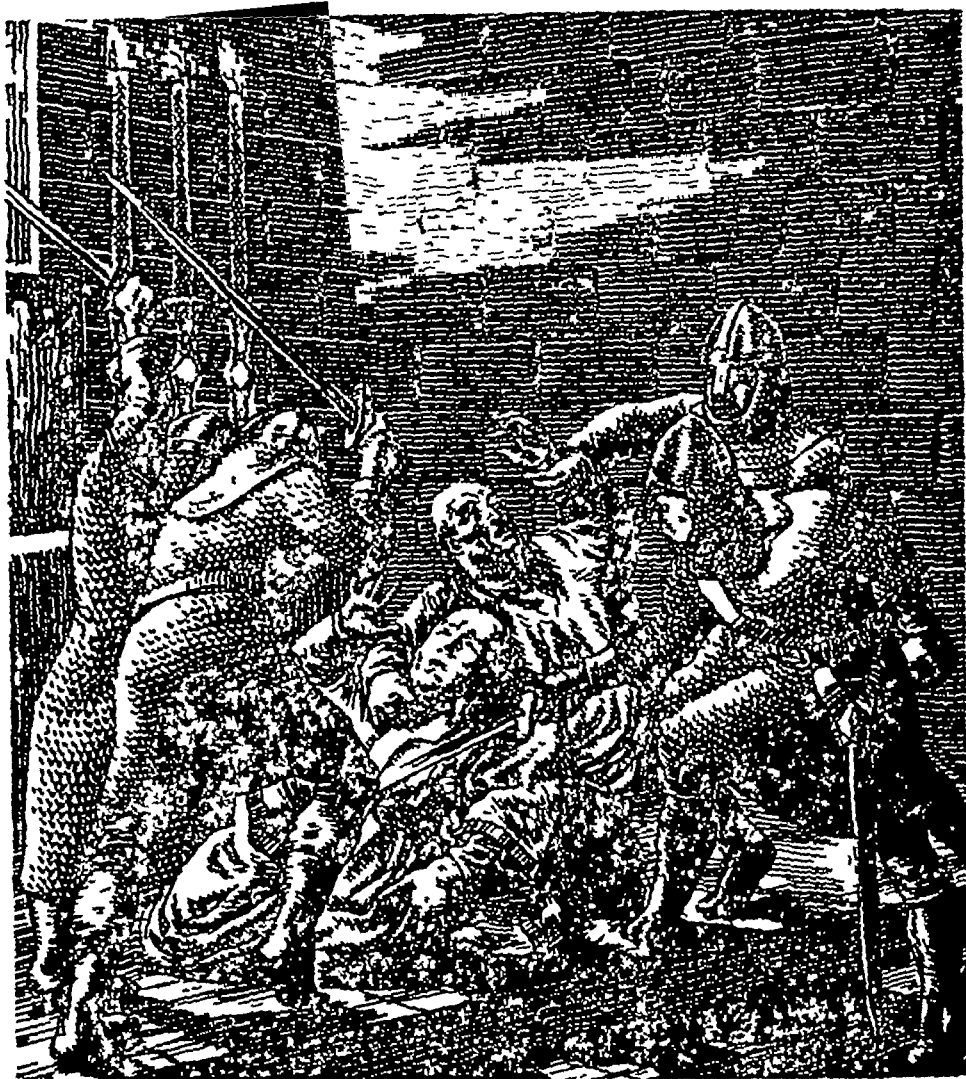
Henry made many legal reforms. He appointed judges, trained in the law, to travel over the kingdom to try offenders, this custom continues in the present day in our assize courts. The jury system was developed, but rather as witnesses than to give a verdict as in the case of modern juries. Henry tried but failed to bring the clergy under the common law, instead of their being tried by Church courts. This led to a quarrel with Becket, Archbishop of Canterbury, hitherto

the king's friend, and for six years Becket lived in exile in France. Then the quarrel was patched up (1170), and Becket returned to Canterbury. Stories reached Henry in France that Becket was plotting against him. He flew into a rage, crying, "Will none of the cowards who eat of my bread rid me of this troublesome priest?" Four knights at once crossed to England, and a few days later murdered Becket in his cathedral. (See picture on page 286.) This terrible crime caused a thrill of horror throughout Christendom. Henry performed public penance, and was scourged by the monks as he knelt before Becket's tomb.

Henry's later years were troubled by the rebellion of his sons who plotted with the King of France against their own father. When the old king learned that his youngest and favourite son, John, had joined the rebellion, he could bear no more, and he died soon afterwards.

HENRY III (reigned 1216-1272), son of King John, was only nine years old when he became king. His reign was marked by the crowds of foreign favourites who beset the king. The barons, led by Simon de Montfort, took up arms against the king, but were defeated by the Prince of Wales (afterwards Edward I). The rebuilding of Westminster Abbey is a noble monument of a troubled reign.

HENRY IV (reigned 1399-1413) was the first of the Lancastrian kings. He was the son of John of Gaunt, youngest son of Edward III. He deposed his cousin, Richard II (son of the Black Prince). His reign was marked by many rebellions, including that of the Welsh under Owen Glendower, and the rebellion of the Percies, who were defeated at the Battle of Shrewsbury. The persecution of the LOLLARDS, the



Murder of Becket in Canterbury Cathedral by four knights for his share in this, Henry II performed public penance See page 285

followers of the religious reformer, John WYCLIFFE, began in this reign

HENRY V (reigned 1413-1422) fought in his youth against Owen Glendower After his accession he renewed the war against France, landed at Harfleur, and won the Battle of Agincourt (1415) See HUNDRED YEARS' WAR He married the French princess, Catherine, and was recognized as heir to the French crown, but died in 1422, a few months before the King of France He was succeeded by his infant

son, Henry VI Like his father, Henry V carried on the persecution of the LOLLARDS

Shakespeare wrote a great play about his reign

HENRY VI (reigned 1422-1471) was one of the most unfortunate of English sovereigns His reign saw the end of the HUNDRED YEARS' WAR, and the loss of all the English possessions in France except Calais At home the country was divided into rival parties, struggling for power over the weak mind of the

king This led to the Wars of the ROSES, so-called because the supporters of King Henry were a red rose, and the supporters of the Duke of York, his rival to the English throne, wore a white one The Yorkists were victorious, the young Prince of Wales was slain after the Battle of Tewkesbury (1471), and King Henry died in the Tower a fortnight later Henry VI was a gentle, kindly man, his love for learning was shown by his founding of Eton College, and King's College, Cambridge

HENRY VII (reigned 1485-1509) was the first of the Tudor line of sovereigns He was the son of Edmund Tudor, a Welsh knight, whose father had married Catherine, the widow of Henry V Henry's mother, Margaret Beaufort, was a descendant of John of Gaunt, son of Edward III Henry was chosen as leader of the "Red Roses," and landed at Milford Haven to fight for the crown (1485) He met and slew Richard III at Bosworth, and was crowned on the battlefield He afterwards married Princess Elizabeth of York, daughter of Edward IV, and heiress of the House of York, thus uniting the Red and White Roses See ROSES (WARS OF THE)

Henry VII was a lover of peace, and although there were two rebellions headed by pretenders—Lambert Simnel and Perkin Warbeck—the country was weary of war Under Henry VII, the merchant class of England became powerful It was an age of trading and EXPLORATION Columbus sailed west and reached America, the Bristol merchants sent out the Cabots who reached Newfoundland, and the Portuguese reached India by way of the Cape of Good Hope This reign marks the beginning of modern history

HENRY VIII (reigned 1509-1547), son of Henry VII, reigned at a critical period in the history of Europe The first twenty years of his reign saw him under the influence of his powerful chancellor, Cardinal Thomas Wolsey, and England began to play a part in European politics Henry joined the Holy League (1511) with the Pope and Spain against France, for Wolsey aimed at keeping the BALANCE OF POWER between the French king and the Emperor Maximilian Henry invaded France, took a few towns, and defeated a French army in a skirmish

While Henry was absent in France, a Scottish army invaded England, but was defeated at Flodden in Northumberland The Scottish king, James IV, was slain



Henry VIII, bluff King Hal

The French king, Louis XII, died in 1515, the next year, Henry's father-in-law, the King of Spain, died, and then the Emperor Maximilian (1519). The emperor was succeeded by his grandson, CHARLES V, the new King of Spain, and nephew of Henry's queen, Catherine of Aragon. The new emperor was only nineteen years of age, and Francis of France and Henry of England were both young men.

Wolsey arranged a friendly meeting between King Henry and King Francis which, because of the display of magnificence, was known as the Field of the Cloth of Gold (1520). But Henry also met the emperor, and entered into a secret treaty against France. An English army again invaded France, but Parliament was not prepared to vote enough money for the venture, Wolsey tried to force people to lend money, and became unpopular.

Another important man at that time was the German religious reformer, Martin LUTHER, who in due course defied the Pope. Henry VIII wrote a book condemning Luther's teaching, and sent a copy to the Pope. The Pope gave Henry the title of *Fidei Defensor* (Defender of the Faith), which English kings still retain, and which still appears in a shortened form (Fid Def or F D) on British coins.

In 1529 Henry asked the Pope to allow him to divorce his wife, Catherine, and expected Wolsey to help him to win the Pope's consent. When Wolsey failed to do so, he was dismissed from his chancellorship, and later arrested for treason. He died on the way to London.

Henry then began the REFORMATION movement in England and declared himself head of the Church. Sir Thomas More, the new chancellor, refused to acknowledge Henry's right to break with the Pope in

this way, and this learned and pious statesman was put to death (1535). Then, with the help of Thomas Cromwell, Wolsey's former secretary, Henry proceeded to close all monasteries and nunneries, and to seize their lands and treasure (1535-1539).

During this reign, the Bible in English was placed in churches. Another good work was the great improvement in shipbuilding. Henry VIII may be called the founder of the Royal Navy which fifty years later defeated the Spanish Armada.

HERA is the Greek name for JUNO.

HERACLES is the Greek name for HERCULES.

HERBACEOUS BORDER. The best site for a flower border is one which rises gently from front to back, and is not shaded by overhanging trees. If possible it should be backed by a wall on which climbing plants can be trained. The site should be cleared and forked over and a liberal supply of well-rotted stable manure spread over it and dug in.

A well balanced arrangement needs thought and care. To avoid muddle, plan the whole thing on paper first. If the plan is drawn to scale and marked off in squares, each representing one square yard, the positions of the various plants may be more easily decided upon before they are put in. If PERENNIALS are chosen they will continue to flower year after year with very little attention being given to them.

Three points should be observed.

(1) The time of flowering. It should be arranged that as the earlier plants die off later plants are beginning to bloom.

(2) The heights of the plants. In order to avoid hiding any of the flowers the taller-growing ones should be planted at the back.

(3) The colours of the plants Care should be taken to avoid having next to each other flowers whose bright colours will clash See FLOWER GARDEN

HERCULES (Greek Heracles) is in CLASSICAL MYTHOLOGY the best-known hero of olden times, noted especially for his Twelve Labours or famous deeds, e.g. fighting with the Nemean lion, seizure of the girdle of the queen of the AMAZONS, cleansing of the stables of Augeus, fetching the golden apples from the garden of the Hesperides. He was finally carried off by the gods to OLYMPUS where he married Hebe.

HEREDITY. Every parent plant or animal passes on to its offspring some of its physical characters. The way in which this happens is governed by the laws of heredity. Plant and animal stock can be improved by breeding from individuals which will pass on desired characters, such as a high yield of seed or specially beautiful flowers in plants, or a large amount of milk from cows or particular type of fur in rabbits. In human beings characters like hair or eye colour, shape of nose or hands, and some defects such as COLOUR-BLINDNESS are inherited.

HERMES is the Greek name for MERCURY.

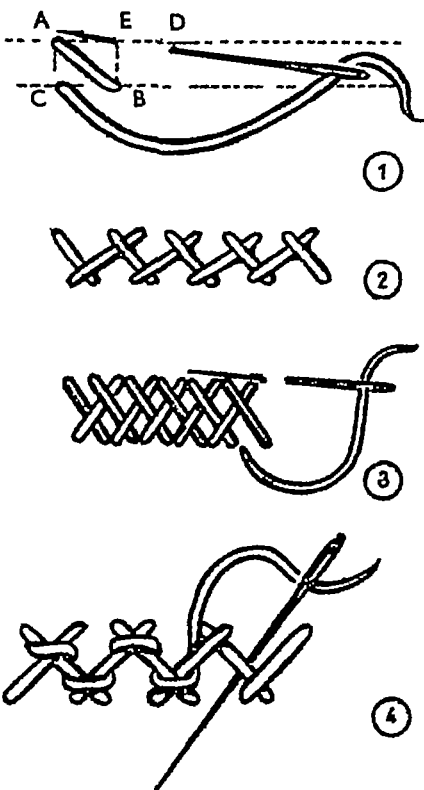
HERO and LEANDER. In CLASSICAL MYTHOLOGY Leander was a young man of Abydos who every night swam the Hellespont to visit Hero, the priestess of VENUS. One night he perished in a storm and Hero in her despair threw herself into the sea.

HEROIC COUPLET. See PRO-SODY.

HERRICK, Robert (1591-1674). From 1629 to 1647 Herrick was vicar of Dean Prior, Devonshire, ceasing to hold the office during the Commonwealth but returning

in 1662. Some of his poems were religious, these were called *Noble Numbers*, but most are sweet, dainty, and sometimes merry lyrics on the good things of country life.

HERRINGBONE STITCH, a decorative stitch in needlework. Work from left to right. Secure the thread with BACK STITCH at A. Insert the needle at B, and bring it out at C. Return to the top line, inserting the needle at D and bringing it out at E. Repeat for the



Variations of herringbone stitch

length required (see 1). A complete row is shown in (2).

Closed herringbone has the stitches close together (see 3), and on the reverse side two rows of backstitching will be seen.

Interlaced or laced herringbone is a fancy form of this stitch (see 4).

HERTZ, Heinrich (1857-1894), a German physicist who first produced WIRELESS waves experimentally

HIBERNATION. In Britain and the North, food for animals is scarce in winter, whether it be vegetation, flies and other insects, or water animals. Rabbits and hares can find grass, moles, worms, and otters, fish. But dormice, squirrels, hedgehogs and bats, snakes, lizards and tortoises, and frogs, toads and newts find a secluded place in autumn and fall into a deep, prolonged sleep. Some wake and find food at intervals on mild days. Others, like the dormouse, hibernate till late spring. The temperature of the warm-blooded animals falls, the heart beats slowly, and breathing is also very slow.

HIGHEST COMMON FACTOR. See FACTORS

HIGH-SPEED STEEL is a steel ALLOY used for lathe tools which retains its cutting edge even when red hot, consequently cutting with it is much quicker than with ordinary steel tools. The alloy contains about 15 per cent tungsten, 4 per cent chromium and 1 per cent vanadium.

HIKING is walking in the country as a means of recreation. A

"hike" signifies that one or more nights are to be spent away from home—a walker returning home the same day does a "ramble." Hiking is best done in the summer when the days are long and warm. It is well to wear stout shoes, and woollen stockings, in hot weather, shorts and shirts for boys, and skirts and blouses for girls, in cool weather warmer clothing such as a jersey, jacket, or jumper should also be worn.

To keep your feet fit, practise walking before the hike, and during the hike wash the feet regularly; if a blister appears, prick it with a needle sterilized by having been held in a match flame, squeeze out the fluid, dab with iodine, dust with boracic powder, then put on boric lint held in place with a strip of sticking plaster.

The best way to carry necessities is in a rucksack with a firm frame that evenly distributes the weight, preferably one with pockets on the outside. In it should be a macintosh, an old soft hat for strong sun or rain; a compass and map of the district, knife, notebook, torch, and first aid tin, spare clothes if it is an extended tour. Food for the midday meal, best taken with you as you cannot tell where you may

be at midday, can be kept in a tightly closed tin. A vacuum flask or water bottle is also useful. At teatime you can usually arrange to be heading for a town or village, and a meal then is not difficult to obtain. If you are spending your nights in a tent, you will need to carry much of the equipment necessary for CAMPING. Otherwise, for members of the Youth Hostel Association there are hostels in the best hiking districts,



Hiking is a fine form of recreation

while other places are tea-shops, small guest houses and hotels or quaint old inns, where you can get bed and breakfast for an inclusive charge

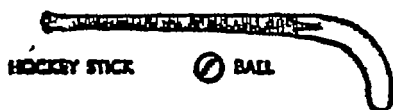
See CYCLING and MAP.

HINDUISM is the ancient religion of INDIA. The Supreme God is Brahma, the spirit of the universe, but there are many other gods, of whom the most important are Vishnu and Siva. It teaches that when men die, their souls may be born again to live in other bodies or in animals, the rebirth being called reincarnation. Hindus are organized into castes, or groups, which do not intermarry or eat together or mix in worship. These are based on differences of occupation, origin and social status. Hindus are united in their reverence for the cow, which they consider a sacred animal.

HIPPOPOTAMUS. See **HOOFED MAMMALS**

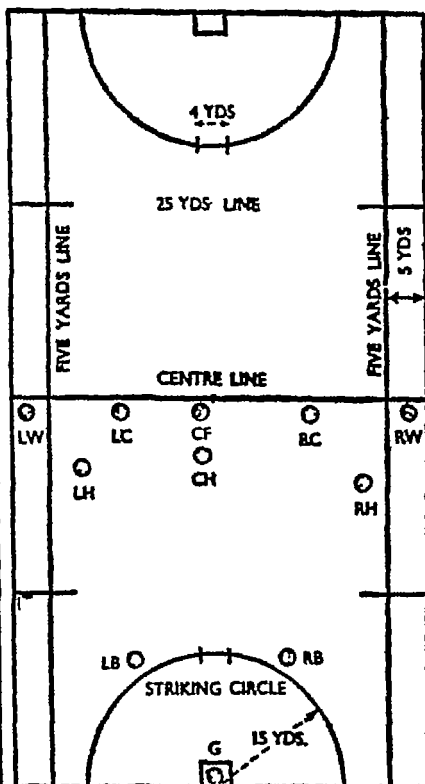
HIRE PURCHASE is the system of buying goods whereby the goods are given on part payment on condition that the rest of the purchase price is paid by instalments. The goods do not become the complete property of the buyer till the last instalment is paid.

HOCKEY is a game for two teams of eleven each, played with a cricket ball painted white or made of white leather, with sticks curved at one end and having one flat side for hitting the ball, and on a ground 100 yards long and from 55 to 60



What you need for hockey

yards wide. A game lasts for 70 minutes, 35 each way, the players changing ends at half-time. Each



Hockey pitch and players

team has five forwards, three half-backs, two backs and also a goalkeeper.

To start the game the two centre forwards stand facing each other in the centre of the field, with the ball between them, with their left shoulders to the opposing goals, they tap first the ground beside the ball, then the opponent's stick, three times altogether, before each tries to hit the ball in the general direction of the other's goal. This is called the *bully*, and takes place also after each goal and some fouls. The positions of the other forwards, half-backs, backs, and goalkeeper are shown in the diagram.

The object of the game is to get the ball into the opponent's goal. the ball must be struck from inside the marked circle to count.

The ball may not be thrown, held or kicked, but it may be stopped with the hand, provided that it falls to the ground immediately below the hand, or with the foot, provided it does not travel otherwise it is counted as a kick, except when the goalkeeper in his own striking circle kicks it. The ball may be hit with the face of the stick only, and the stick may not at any time be raised above shoulder level. No player may aim at an opponent's stick or otherwise attack another player.

The penalties in hockey are (a) a free hit, (b) penalty bully, (c) corner, (d) penalty corner.

When a free hit is being taken the other players must be at least 5 yards from the striker, who may not hit the ball again until it has been touched by another player. In a penalty bully, the players other than those taking the bully must remain behind the nearest 25 yards line.

If a defending player unintentionally and when within 25 yards of his goal-line hits the ball over his own goal-line (not into the goal) the attacking side is awarded a "corner"; the corner hit is taken from a point on the side-line or goal-line within 3 yards of the nearest corner flag. If the referee decides that such a hit across the goal-line was intentional a "penalty corner" is awarded, a free hit taken by an attacking player at a distance of not less than 10 yards from the nearest goal-post. All the other members of the attacking team line up round the outside of the goal circle while the defending team stand behind their goal-line.

If the ball is sent over the goal-line by an attacker, the ball is got into play again by a bully being taken on the nearest 25 yards line, the players standing on their own

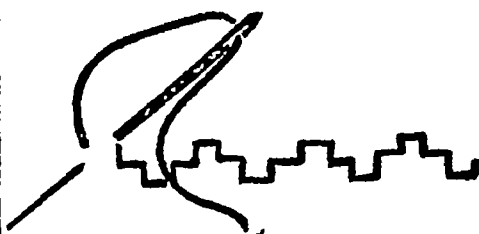
side of the line. If a player sends the ball out of play over the side-line, it is rolled into play by a member of the opposing team, the other players standing not nearer than the 5 yards line (for women—7 yards for men's games).

Free hits are awarded against a side infringing the rules. Fouls committed by the defending team within their own striking circle are penalized by a penalty corner or a penalty bully.

HOEING is clearing the **WEEDS** with a hoe from the neighbourhood of growing plants so as to loosen the soil and allow the air to get into it. If hoeing is done well and regularly there is less need to water the plants, for the disturbing of the soil helps to keep in it any moisture already there. Between March and September the hoe should rarely be idle.

See **GARDENING TOOLS** and **ALLOTMENT GARDENING**.

HOLBEIN STITCH is made up of a series of **BACK STITCHES** worked to form a pattern. It is easier to work this stitch on coarse material where the threads can be counted and the stitch made even. It is



Design in Holbein stitch

sometimes called double running stitch when worked in two journeys of **RUNNING STITCH**, but the finished effect is the same.

HOLLAND. See **NETHERLANDS**.

HOLY ALLIANCE, a league entered into after the downfall of Napoleon (1815) by the sovereigns

of Russia, Austria and Prussia It was proposed by Tsar Alexander I who believed in the Divine Right of Monarchs, and it was supposed to conform with the words of Holy Scripture which "command all men to consider each other as brethren." But the real leader in Europe at that time was Prince Metternich, Chancellor of Austria He wanted to suppress revolution everywhere, and the alliance, instead of helping to attain true brotherhood, became an instrument of oppression The wise British Foreign Minister, Lord Castlereagh, regarded the alliance as "a piece of sublime mysticism and nonsense," and strongly refused to allow the Prince Regent to join it

HOLY COMMUNION is a Christian SACRAMENT which comes from the Last Supper, when Christ first commanded His followers to partake of bread and wine, telling them that they were His Body and Blood The service at which Christians receive the bread and wine is sometimes called the Eucharist or Mass

HOLY GHOST. See **HOLY SPIRIT**

HOLY SPIRIT (or Holy Ghost) In the **NEW TESTAMENT**, the Holy Spirit is God at work in the world In Christian belief the Spirit works where He chooses, partly in all men, but especially in the Christian Church See **TRINITY**

HOMER (8th century B C) was the great epic poet of Greece to whom are attributed the *Iliad* and the *Odyssey* He is said to have wandered, a blind minstrel, from town to town The *Iliad* tells of the war between Greeks and Trojans for **HELEN**, wife of Menelaus of Sparta, who was carried off by **PARIS**, son of Priam, King of Troy Achilles, the Greek hero, is the central figure of the poem The *Odyssey* relates the adventures of

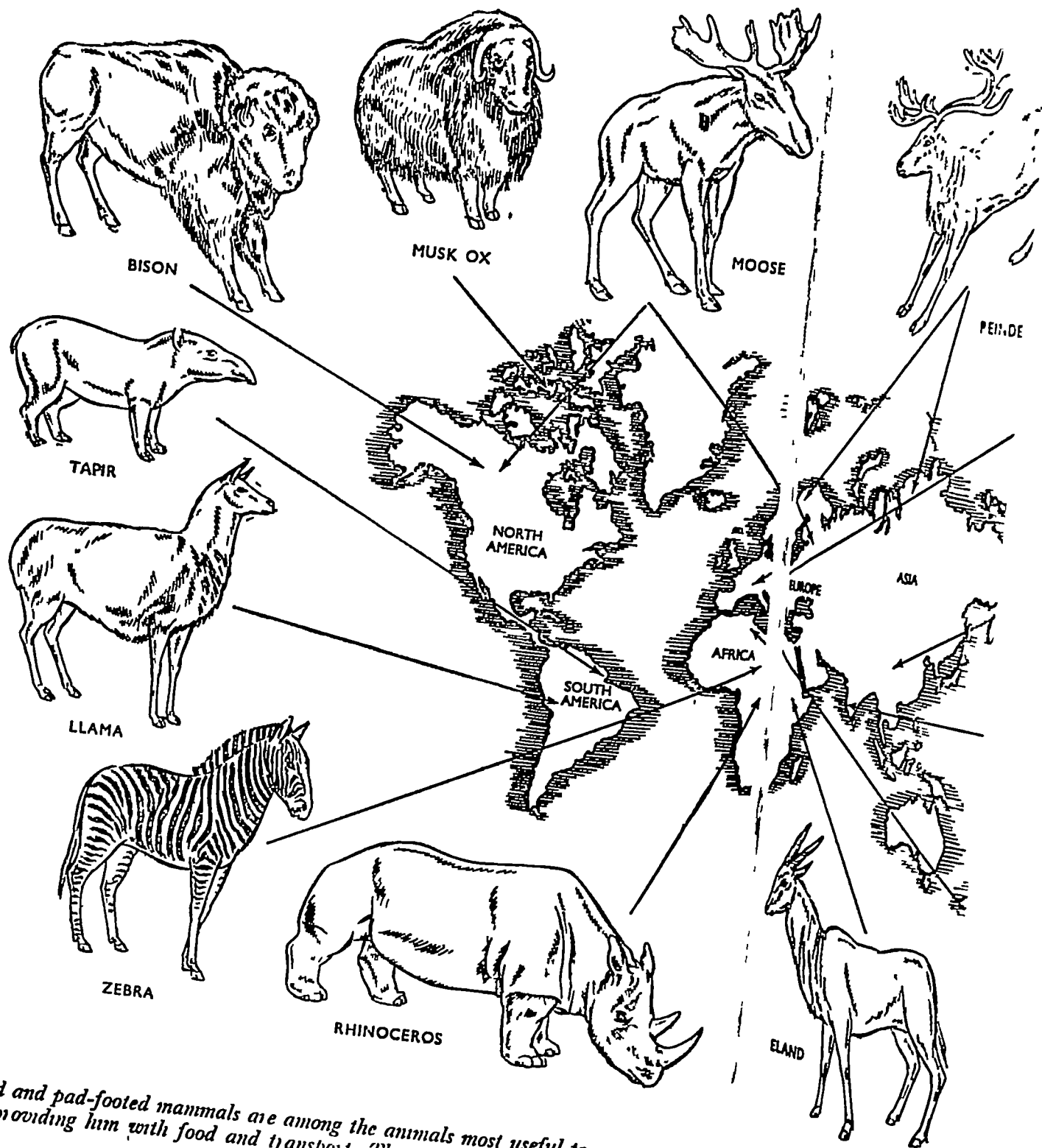
ODYSSEUS, ruler of Ithaca, as he returned from the Trojan War

HONDURAS, a small republic of Central America The capital is Tegucigalpa Its products include bananas, coffee and tobacco See map of **CENTRAL AMERICA**

HONG KONG. See **CHINA**

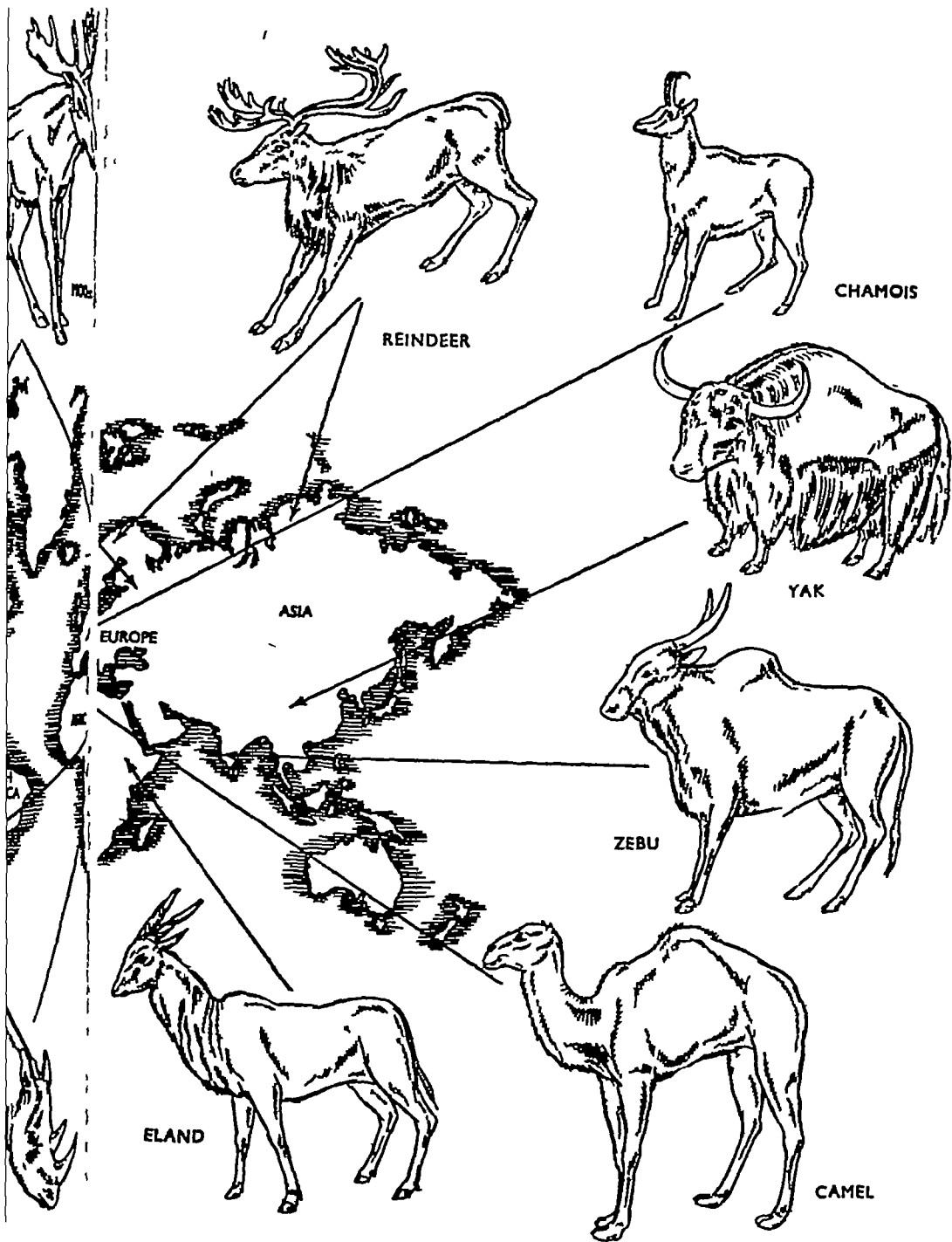
HOOD, Thomas (1799-1845), an early Victorian writer best known for such humorous poems as "Ben Battle" Of his serious poems "The Song of the Shirt," the complaint of an overworked sempstress, is best known

HOOFED MAMMALS are one order of **MAMMALS** including pad-footed animals, many bearing also horns or antlers The hoof is a very much enlarged and strengthened nail The horse, ass and striped African zebra have only the middle toe left on each foot The rhinoceros and the tapir have kept three toes in use The horn of the rhinoceros, single in the Indian species, double in those from Africa or the Far East, is formed from fused hair The types of hooved animals with two or four remaining toes include cud-chewing vegetarians, as well as the hippopotamus and omnivorous pig tribe (the wild boars, warthogs, peccaries, etc) These often grow long tusks, which they use for rooting up food and as weapons Hippopotami live in rivers and swamps, eating bushels of water plants and sleeping piled-up in groups on sunlit mudbanks The cud-chewing hooved animals swallow a huge amount of vegetable food quickly into a storage pouch, and retire to chew and digest in seclusion from enemies The domestic cow and many other types of cattle, together with the related sheep, goat, antelope and deer tribes all have a cloven hoof, with two of the four toes usually touching the ground Horns of cattle



Hoofed and pad-footed mammals are among the animals most useful to man, often providing him with food and transport. They vary considerably from

one part of the world to Britain—each arrow points to



one part of the world to another, and above are seen some that live outside Britain—each arrow points to where the animal is to be chiefly found

and buffalo are permanent hollow growths from bony knobs on the skull. Deer antlers are shed yearly, and re-grown with an extra point. At first they are covered with sensitive "velvet," but this later wears off. Many hoofed animals live in huge herds, as do the North American bison and African gnu, which often associates with zebras. Others, like giraffes, which may be 18 feet high, live in smaller family groups. Hoofed animals are often used as beasts of burden—the llama in the Andes, the yak in Tibet, the reindeer in the Arctic, and the two-humped Central Asian Bactrian camel and the single-humped riding dromedary in Egypt and Arabia. See **TRANSPORT**. Different types of horse are used for different purposes, the strong Clydesdale and shire horses on the farm, thoroughbreds and Arabs for racing. Then there are Welsh, Dartmoor, and the hardy little Shetland ponies, and many others.

HOOKS AND EYES. To sew on the hook, work **BUTTONHOLE STITCHES** close together over the rings of the hook. Make a few **BACK STITCHES** over the shank between the holes and under the hook. Fasten off on the wrong side. To sew on the eye, work buttonhole stitch over each ring, and fasten off as before. Another form of eye and the method of securing it are also shown.

Sometimes instead of a metal bar, a worked bar of thread is used to make this lay several strands of

the length desired on the material, finishing each strand with a back stitch and then work buttonhole stitch closely over the bar of thread now formed.

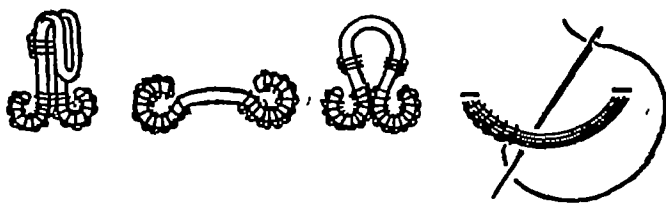
HORN. The orchestral horn (sometimes called the French horn) which is in use today consists of a long tube of brass (about twelve feet long), curled up so as to be easily handled, with a mouthpiece at one end and a large bell-shaped opening at the other. The sounds are made by the player's lips setting the column of air in motion, and are varied by his using different lip-pressures and by the valves, which alter the length of the tube. The horn has a peculiarly lovely tone, and is used for solos or in combination with the woodwind or the **BRASS WIND INSTRUMENTS**. An early type of horn was much used in outdoor sports, and is known as the hunting horn. It has no valves, and only a limited number of notes.

On page 405 are pictures of these two horns.

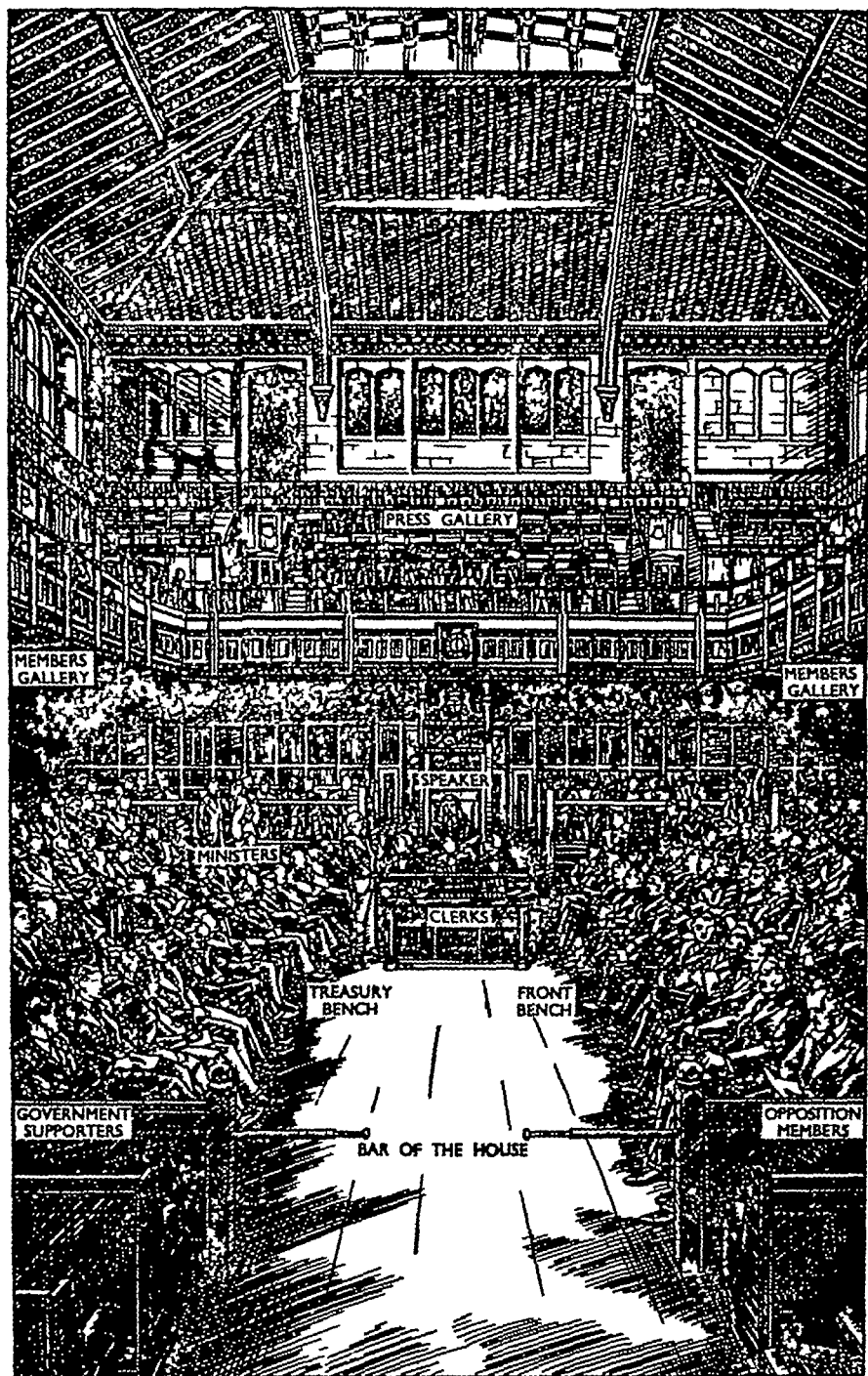
HORNET. See **BEE**.

HORSE, a **HOOFED MAMMAL**, one of the commonest of **DOMESTIC ANIMALS**, used all over the world for **TRANSPORT**.

HOUSE OF COMMONS, meets in a large room in the great building called the Houses of **PARLIAMENT**. The chamber was destroyed in an air raid during the Second World War. In its rebuilt form, it will look very much as it did before the war. Along the middle of the room runs a wide passage or gangway with rows of seats rising up from each side of it. At the head of the gangway on a raised chair sits the *Speaker* who



How to put on hooks and eyes



Inside the House of Commons, showing Ministers and Government supporters on one side, and the Opposition members on the other

presides over the House. He is called the Speaker because in former days it was his duty to speak for the Commons when petitions were presented to the King. On the seats at his right sit the supporters of the Government. The first row of seats is called the *Treasury Bench* and on it sit the Prime Minister and other Cabinet Ministers. Other Ministers sit on the seats behind these. On the other side of the gangway sit the other party or parties who form the *Opposition*.

The King's Speech. Parliament opens each session with the reading of the King's Speech. This speech, though read first by the King to the House of Lords, is prepared by the Cabinet. It contains an outline of the policy which the Government proposes to pursue. When the speech has been heard and approved by both Houses, Parliament proceeds to its work—the introduction of legislation, its discussion and its enactment following the necessary votes of approval. See **BILLS (PROCEDURE IN PASSING)**.

Question Time. Important to democracy is the right of private members to address questions to the ministers in charge of Government Departments. By this means the Opposition can make known to the country at large matters which the Government might have preferred to ignore. It is, too, a way of making unpleasant facts known to the responsible head of a department. On the minister's answer will depend the impression made upon the country.

Dissolution of Parliament. Normally Parliament is dissolved at the end of five years (see **PARLIAMENT**). If before that time the Government is defeated over some important bill, the Prime Minister may do one of two things. (1) He may advise

the King to dissolve Parliament, in which case a general election takes place. (2) He may advise the King to send for the Leader of the Opposition and ask him to form a new Government.

HOUSE OF LORDS. See **PARLIAMENT**.

HOUSEWIFERY is the efficient running of a house, and embraces problems of widely different natures. It includes the problem of running the house economically, seeing that the money available is spent to the best purpose. It includes keeping the house clean, for cleanliness and hygiene are the basis of healthy living. It includes a knowledge of the choice of foods, and how to cook them, for if not properly fed, the members of the household cannot be expected to exert their full effort. It includes, too, a knowledge of **LAUNDERING**, without which the household and its members will look shabby and make a poor impression on the outside world. The good housewife must also have a knowledge of sewing, so as to keep the family linen in good repair. A knowledge of **FIRST AID**, too, is useful to enable her to meet emergencies, and she should keep a small medicine cupboard, suitably stocked, for this purpose. And if one is fortunate enough to be able to afford all sorts of machines and gadgets, it includes the knowledge of how to use them properly, so that they are not always going wrong.

See also **CROCHET**, **DARNING**, **EMBROIDERY**, **STITCHES**, **KNITTING**, **CAKE-MAKING**, **DIET**, **FISH**, **JAM-MAKING**, **KITCHEN MEASURES**, **MEAT**, **PASTRY-MAKING**, **PICKLING**, **VEGETABLES**.

HUGO, Victor Marie (1802-1885), novelist, dramatist, essayist and poet, was a great figure in the French romantic movement. He

wrote *Les Misérables* and *Les Travailleurs de la Mer* in the Channel Islands, where for a time he took refuge following his democratic political activities.

HUGUENOTS, the name given to the French Protestants of the 16th and 17th centuries. During the 16th century, the Huguenots were cruelly persecuted. On 24 August, 1572 (St Bartholomew's Day), thousands of Huguenots

were massacred in the streets of Paris by order of Catherine de Medici, the French king's Italian mother. In 1598, the Edict of Nantes gave freedom of worship to the Huguenots, but this edict was set aside about a hundred years later (1685), and they had to become Catholics or leave the country. As a result, many French Protestants came to England, and set up the work of silk-weaving in Spitalfields (London), Coventry and other parts of the country.

HUMIDITY. Water evaporates into the air, somewhat like sugar dissolving in water. The higher the temperature the more the water evaporates.

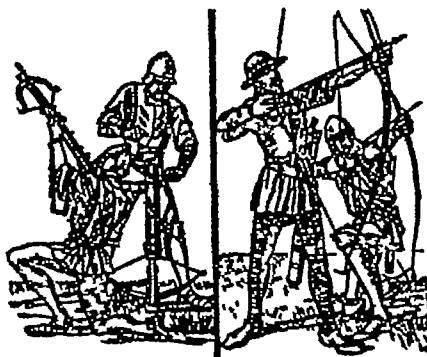
If the air cools, then the water vapour begins to condense, if it cools below a certain temperature the water is deposited on any nearby object. Hence we get dew.

Air feels humid or damp when it is nearly saturated, and then water only evaporates into it slowly. On the other hand, on a good drying day—be it hot or cold—the air is not nearly saturated and, if it is kept moving as wind, will soon

take up water from the ground or from clothes that are hanging out to dry.

HUMUS is that part of the soil composed of decayed vegetable and animal matter. It is rich in plant foods, and its presence is indicated by the darker colour and spongier texture of the soil at the surface layer.

HUNDRED YEARS' WAR, began in 1338 when Edward III

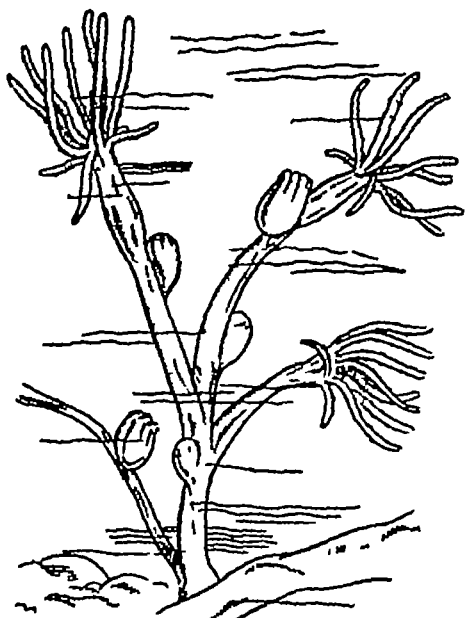


French and English bowmen

claimed the French crown, his mother, Isabella, being the daughter of one French king and the sister of two others. In the early part of the war occurred the naval battle off Sluys (1340), the Battle of Crécy (1346), which was won

by the English long-bowmen, the Siege of Calais (1347) and the Battle of Poitiers (1356). This was a period of success for the English. At Poitiers King Edward's son, the Black Prince, captured the French king, John, and brought him a prisoner to England. The conditions in France were very wretched at that time; besides the devastation and miseries caused by English armies, the French peasants (the Jacquerie) rose in rebellion.

The Treaty of Brétigny marked the end of the first period. It gave England the town of Calais (an important market for the English wool trade) and other territory in France. Edward III was getting old, and his son, the Black Prince, was ill, and gradually the French regained their lost lands. Edward III and his son died in 1377. After 1386 there was a lull in the war.



Hydra, a pond animal

The war was renewed in 1415 when Henry V, taking advantage of strife between rival parties in France, invaded the country, and won the Battle of Agincourt. This began a second period of success for the English, and in five years Henry and his French allies were masters of France. By the Treaty of Troyes (1420) Henry agreed to marry the French princess Catherine, and was recognized as heir to the French crown, setting aside the Dauphin, the rightful heir. But Henry V did not live long enough to complete his triumph. He died in 1422, leaving an infant son to succeed him.

The last period of the war was marked by the courage and faith of the young and wonderful Joan of Arc, the Maid of Orleans, who roused the French to a new sense of patriotism. Although Joan was captured and put to death, her influence lived on. By 1453, the English had lost all the territory they had won in France except Calais, and the Hundred Years'

War came to an end. A new France had been born.

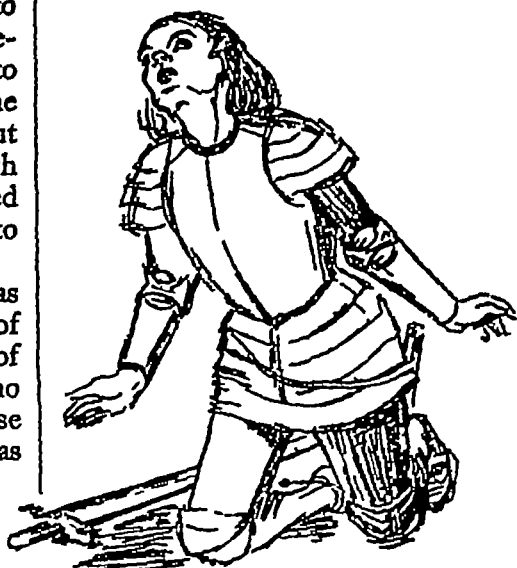
HUNGARY is an agricultural country in the centre of Europe, adjoining the Balkans. Budapest, the capital, is the only large town. On the grassy plains large numbers of cattle, sheep, pigs, poultry and horses are reared, and cereals and potatoes are grown. Grain is the chief export.

See also **AUSTRIA** and the map of the **BALKAN PENINSULA**.

HYDRA, a pond animal related to the **CORAL** and **SEA-ANEMONE**. Green, brown, and grey species occur, stretching to 1 inch or contracting to $\frac{1}{16}$ inch. Long tentacles, which catch water-fleas for food, surround each mouth.

In **CLASSICAL MYTHOLOGY** the hydra was a many-headed monster, the slaying of which was one of the labours of **HERCULES**.

HYDRAULIC MACHINERY is operated by the pressure of water or some other liquid, e.g. oil. Hydraulic power is sent through pipes from a motor-driven pump to the machine to be worked. A



Joan of Arc prays for victory

simple hydraulic system is used to operate the brakes of certain motor cars

HYDROCARBONS are an important group of **ORGANIC COMPOUNDS** which contain only carbon and hydrogen **PETROLEUM** and its derivatives, including petrol and paraffin, are mainly mixtures of various liquid and solid hydrocarbons They are all inflammable and do not dissolve in water

HYDRO-ELECTRICITY is electricity obtained from the force of falling water which is made to pass through turbines connected to **GENERATORS** The turbine has a series of vanes attached to a drum, as the water rushes through, it pushes these vanes thereby causing the drum to revolve The drum turns a shaft, the other end of which drives a generator, and as the generator revolves it generates electricity, which can be used for light, heat, and power over a wide area See picture on page 302

Water power has been utilized chiefly in North America, Norway, France, Italy, Switzerland, Sweden, Spain and Eire It is cheap, and has given rise to great industries, especially new ones In France and Switzerland parts of the railway system are run by hydro-electricity The coming of hydro-electric power has had great importance for the location of industry. Before, factories had to be built near coal-mines, the source of fuel supply, and so industry was concentrated in certain parts of the country Now the cables bring power to wherever it is wanted, so factories are no longer tied to the coalfields and can be situated wherever conditions are best suited for them

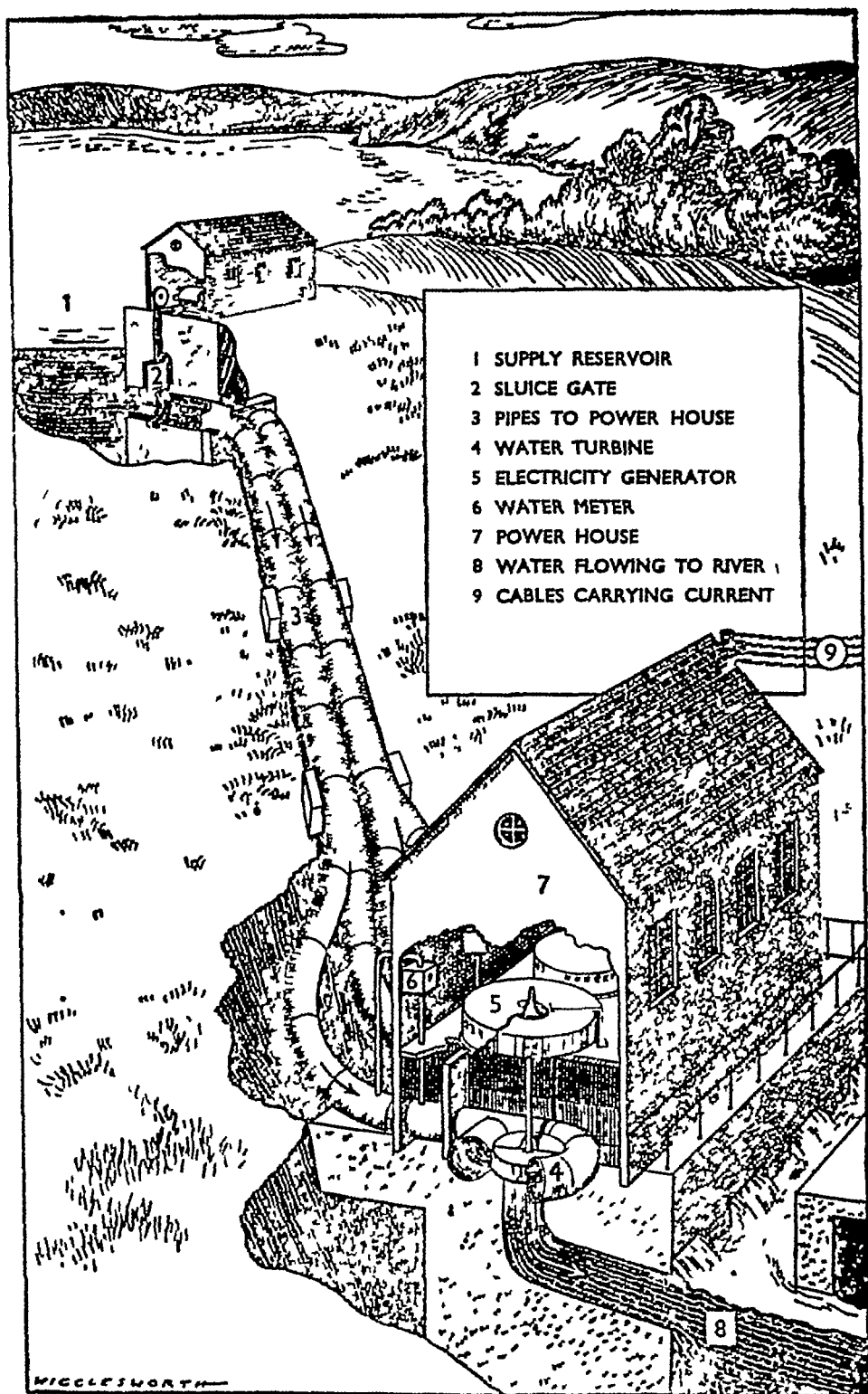
HYDROGEN is the **ELEMENT** of lowest density It is an inflammable gas and is prepared by the action of dilute acid on zinc Water when

electrolysed (decomposed by electric current) gives off one-ninth of its weight as gaseous hydrogen This is one of the ways in which hydrogen is produced industrially for blowpipes, airships, and hard fats, as well as for many other uses

HYDROGENATION. Oils or fats are made up from molecules which contain a long chain of carbon atoms If these carbon atoms have each two hydrogen atoms then the fat will be hard If they have in some instances only one, then the fat will be soft and oily We can take a soft fat or oil and with the help of a **CATALYST**, nickel, add hydrogen where it is lacking and thus produce a much more useful hard fat, e g margarine from whale oil

We can also turn coal into oil or petrol by taking finely ground coal and causing it to combine with hydrogen in the presence of a catalyst Coal, by itself, only contains a small percentage of hydrogen, but if its atoms are caused to combine with a much greater proportion of hydrogen it will turn to a liquid fuel which is much more convenient and valuable than the original solid material

HYDROMETER For the theory that lies behind the action of the hydrometer, see **ARCHIMEDES** When we understand why the hydrometer floats high when in a very dense liquid and low when in a less dense liquid, we can see how useful this instrument is for testing liquids If, for example, spirits have less alcohol in them than they should have, the hydrometer will show this clearly To test, say, acid in an accumulator, it is necessary to have an instrument which will first suck up some of the acid into a compartment in which the hydrometer float is situated On the stem



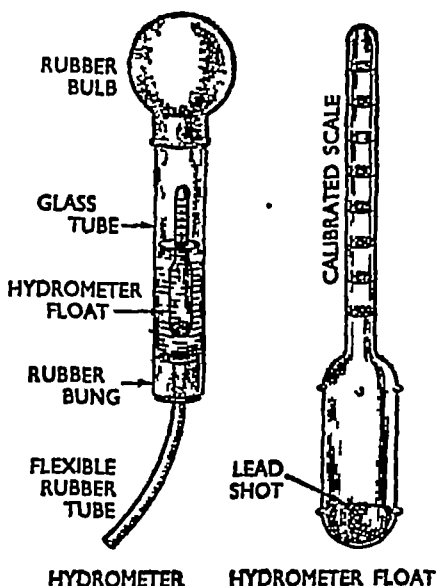
In this example of hydro-electricity, a power house has been built between a reservoir and a river at a lower level water rushes down pipes to revolve the water turbines driving the electricity generators See page 301

of the hydrometer float are marked figures, and the float sinks to the level of one of these figures according to the strength of the acid

HYDROPHONE, an instrument for detecting under-water sounds A **DIAPHRAGM** in a ship's bottom vibrates when sound waves fall on it, and the vibration is transmitted electrically to an operator, who is able to detect the direction of the cause By this means the presence of submarines can be detected

HYENA The spotted or striped varieties of hyena of Africa and India are skulking, night animals which seldom kill strong animals, but attack the weakly or feed on carrion Their powerful jaws will crunch any bones. Besides a weird howl, they make a noise like an hysterical laugh

HYGIENE includes principles and practices by which the health of the individual and of the community are kept at a high level Health services for the community are provided by the State, personal hygiene is the responsibility of each individual Hygiene covers knowledge of sensible **DIET** and clothing, or necessary exercise and rest, and the practice of cleanly habits It is concerned with heating, lighting, ventilation and sanitation, including water supply and disposal of household refuse and of sewage Some knowledge of **PARASITES**, of danger from house-flies and of anti-septic measures is also necessary Cleanly habits are especially essential with regard to skin, hair, nails, teeth and clothing Skin rids the body of some waste matter, and this must be removed, together with dirt from outside, by soap and water Hair, nails and teeth may harbour dust and **BACTERIA** which can contaminate food and spread disease, but which can be removed by thorough washing and brushing

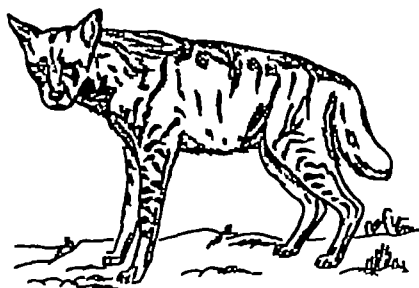


One form of hydrometer for testing liquid, showing enlarged float

Regular emptying of the bowels, a good bodily posture in sitting, standing and walking, and correct breathing are all important

HYMNS. See **CHURCH MUSIC**

HYPOCHLORITES are compounds usually of soda, potash or calcium with oxygen and chlorine, which in solution have bleaching properties Bleaching powder and Eau de Javelle are bleaching agents which contain a hypochlorite They are also used to disinfect water which has sewage or similar contamination and is wanted for use



Hyena of Africa and India



IAMBUS. See PROSODY

IBERIAN PENINSULA, separated from France by the Pyrenees and from Africa by the Straits of Gibraltar, about ten miles across at the narrowest part. The central plateau of Meseta, cold and fairly damp in winter and hot and dry in summer, borders the Atlantic coastlands. Politically the peninsula consists of SPAIN and PORTUGAL, and GIBRALTAR (British) in the south.

IBSEN, Henrik (1828-1906), was a Norwegian dramatist, whose influence on modern European drama

cannot be exaggerated. Most of his plays are studies of men and women and the effect upon them of social conventions, especially marriage upon women. The plays aroused interest in England in particular, as they appeared at a time when women were claiming a larger measure of independence, and "women's rights" formed a topic of general interest. They also showed that the problems of ordinary life could be interesting on the stage, and the English theatre then was sadly in need of inspiration. Two of Ibsen's best plays, *Brand*



Iberian Peninsula, consisting of Spain, Portugal and Gibraltar

and *Peer Gynt*, were inspired by national feeling, and were intended to rouse the better nature of his fellow countrymen. His work includes *A Doll's House*, *Ghosts*, *The Wild Duck*, *Hedda Gabler*, *The Master Builder*.

ICARUS in CLASSICAL MYTHOLOGY is the son of Daedalus, the sculptor, architect, and inventor who built the labyrinth, in which Minos, King of Crete, kept the monster, the MINOTAUR. He made wings for himself and his son Icarus with which they flew over the sea. Icarus flew too near the sun, the wax by which the wings were fastened to his body melted, and he was drowned in the sea, called henceforth after him.

ICE AGE, the recent geological period when a large part of the northern hemisphere land mass was covered by an ice-sheet. In Europe, glacial conditions extended south to about 50 deg N; in North America, to the Great Lakes. The Alps and Pyrenees had great snow-fields and GLACIERS similar to those still remaining in Greenland. As the ice-sheets grew they pushed ground-up rocks and soil outwards. When the climate became warmer they retreated, and stages in the retreat were marked by long ridges of glacial drift. Other remaining features are FIORDS, U-shaped VALLEYS and hanging valleys.

ICEBERG, a drifting mass of ice of which about eight-ninths is always submerged. See GLACIER.

ICE, DRY, is solid CARBON DIOXIDE. It is not stable at normal air temperature, but slowly evaporates. As it does so it cools its surroundings to a low temperature. Its great advantage is that it gives great coldness, is cheap, forms no liquid as it evaporates, and leaves no residue when it has gone, but it is slightly dangerous as it "burns"

bare skin. It is used to keep ice-cream cold in the barrow of the ice-cream man.

ICE HOCKEY is played on ice with a stick and a "puck," a flat circular disk of vulcanized rubber 3 inches in diameter, 1 inch thick, and weighing from 5 to 6 ounces.

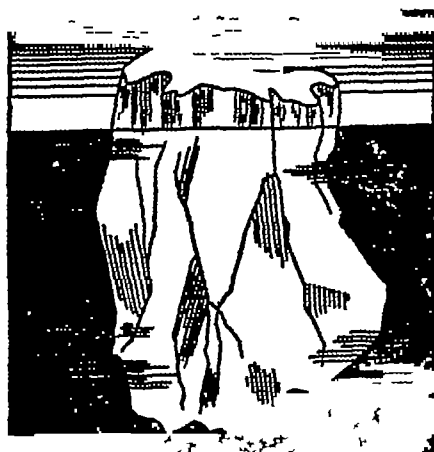
The playing area has a maximum size of 280 feet by 130 feet, but a more convenient size for indoor rinks is approximately 200 feet by 85 feet. This area is enclosed by wooden boundaries about a yard high.

There is a goal near each end of the playing area, with the goal-posts 6 feet apart and enclosed by netting. The goals are placed about 10 feet from the back boundary so that it is possible to skate round them.

A team has six players, their positions are—goal, left defence, right defence, centre, left wing and right wing.

A centre spot is marked in the area and at the start of the game and after a goal the teams take up their places behind the centre spot, facing their opponents' goal.

The goalkeeper stands in the goal, the two defence men place



Iceberg, most of it submerged

themselves 25 yards forward from the goal. The centre and the right and left wing stand in a line behind the centre spot. The referee starts the game by dropping the puck between the opposing centres close to the centre point; each opposing team must keep on-side, that is behind the puck, while pushing or passing it from one player to another towards their opponents' goal. A goal is scored when the puck is driven into the net. A game consists of three twenty-minute periods with ten-minute intervals between them. The team scoring most goals wins.



Example of illumination

ICELAND is a large island in the North Atlantic. Most of it is a bleak plateau, and fishing and sheep-rearing are the chief occupations. There are numerous **GEYSERS** and hot springs and several **VOLCANOES**. The capital is Reykjavik. See map of **GREENLAND**, off which it lies. 9

IDOL, something loved and worshipped instead of God. The heathen made images which represented their gods and which they worshipped in themselves. Statues and pictures are used by many Christians as an outward indication that God fills their thoughts, but are not worshipped in themselves.

IGNEOUS ROCKS are rocks which have not changed since they originally solidified from a liquid condition. Common examples are granite and basalt.

IGUANA. See **LIZARD**.

ILLUMINATION is the decorating of manuscripts with elaborate coloured lettering, scrolls and pictures, particularly with burnished gold. Before the invention of printing monks used to write out copies of books of the Holy Scriptures, psalms, poems, histories, etc. They beautified their pages with illumination, a good example being a manu-

script Bible made by the monks of Kells in Ireland and known as the *Book of Kells*.

IMAGERY (or figures of speech). Writers often increase the beauty and effectiveness of their work by special figures of expression calculated to strike home to the imagination. These special features are called figures of speech, or imagery. They are to be found not only in poetry, but in everyday speech, as, for example, when we speak of a "film star," or say that a dark night is "black as pitch."

When as in the last example, a resemblance or comparison is introduced, we have a *simile*. Here is another:

*I wandered lonely as a cloud
That floats on high o'er vales and
hills.*

When the resemblance is carried further, and the qualities or attributes of one thing are transferred to another, we have a *metaphor*. "The Lord is my shepherd" or "He was a lion in battle," or "She was pure gold."

Antithesis is the setting side by side for contrast of two sharply opposed ideas. "The lion shall lie

down with the lamb " When, in order to arrest the attention of the reader, an author expresses a contrast which on the surface seems nonsense, we have a *paradox* "The child is father of the man " Another form of striking and forceful expression is *epigram*, a clever or pithy saying Here is one from an epitaph

Here lies our sovereign lord the
King

Whose promise none relies on,
Who never said a foolish thing
Nor ever did a wise one

Akin to antithesis and paradox is *oxymoron*, where two opposite ideas are reconciled in one expression "I must be cruel, only to be kind "

Emphasis and effect are often gained in writing by special use of vowel and consonant sounds When consonant sounds at the beginning of words are repeated, the effect is called *alliteration* "a cheap and chippy chopper on a big black block " If words are used which by their sound suggest the idea they contain, we have *onomatopoeia* "murmuring of innumerable bees " See also PROSODY

IMPERIALISM, generally speaking, is the name given to the political idea of having a strong and large empire and doing everything to strengthen and increase it Napoleon had imperialistic ideas as he wished to build a strong empire centring round France Kaiser William of Germany had a similar idea about Germany In Britain Disraeli was an imperialist, advocating a strong and united British Empire

IMPORTS. See EXPORTS AND IMPORTS

IMPRESSIONISM is a style of painting developed mainly in France in the 1880s The "Impressionists" believed that the old way of painting a picture so as to show all the

details with equal clearness was false to what the eye really sees, and lost the true spirit of the scene They would argue that if a cow in the distance looked like a red smudge it should be painted as a red smudge and not as a miniature cow They set out to capture the general *impression* of a scene Further they studied more carefully than did earlier artists the changes produced in the appearance of a scene by the changes of light and atmosphere The same scene looks different in different lights, that is, at different hours of the day and at different seasons of the year So they went into the open air for their subjects and painted the various effects they found there Their paintings open our eyes to the liveliness of colour—to the fact that it is broken into vibrating fragments and that even shadows, instead of being just grey or brown, may, if we look carefully, be seen sometimes to have purple or violet or green in them Their pictures are, therefore, vivid colour harmonies See PAINTING

Take care to stand well back from an impressionist painting so as to catch the broad vivid impression If you are too close, you may see only a chaos of bright colours

Some of the great impressionists were Manet, Degas, Renoir, Monet and Sisley Among those who came after—Post-Impressionists—Seurat, Van Gogh, Cézanne and Gauguin tend to see things with a sharper sense of their design and so make deliberate patterns of their shapes and colours

INCAS, rulers of the Inca Empire which flourished in South America—in Peru and parts of Bolivia and Chile—from about A D 1000 to the conquest of Peru by the Spaniard Pizarro in the 16th century They were highly civilized,



Incas worshipping the sun

and wonderful builders, their chief cities being Cuzco and Quito They worshipped the sun and moon, and the "unknown God," a spirit who pervaded everything They were clever farmers, working on a terrace system very suitable to their mountainous country They were skilled workers in metal, pottery and textiles

Their government was very despotic, arranging all the details of everyday life, but it was a wise, kindly rule, suited to the docile nature of the people of those early days

INCOME is a flow of money coming in, in return for some economic service It is generally measured in money terms If a man has regular work at, let us say, £5 a week then his income is £260 a year If a man has lent the Government £2,000 at $2\frac{1}{2}$ per cent, then he will receive a regular income of £50 a year If another man has a house that cost him £2,000 and he lets it to a tenant for £4 a week rent, then his gross income from that house will be £208 a year. But he may have to

deduct from this amount the cost of maintenance, rates and taxes before he secures his net income Or he might invest £2,000 at 3 per cent in a COMPANY and receive £60 in DIVIDENDS

Whether he has contributed his labour or his capital to satisfy human wants, he receives in return a money payment which is called an income

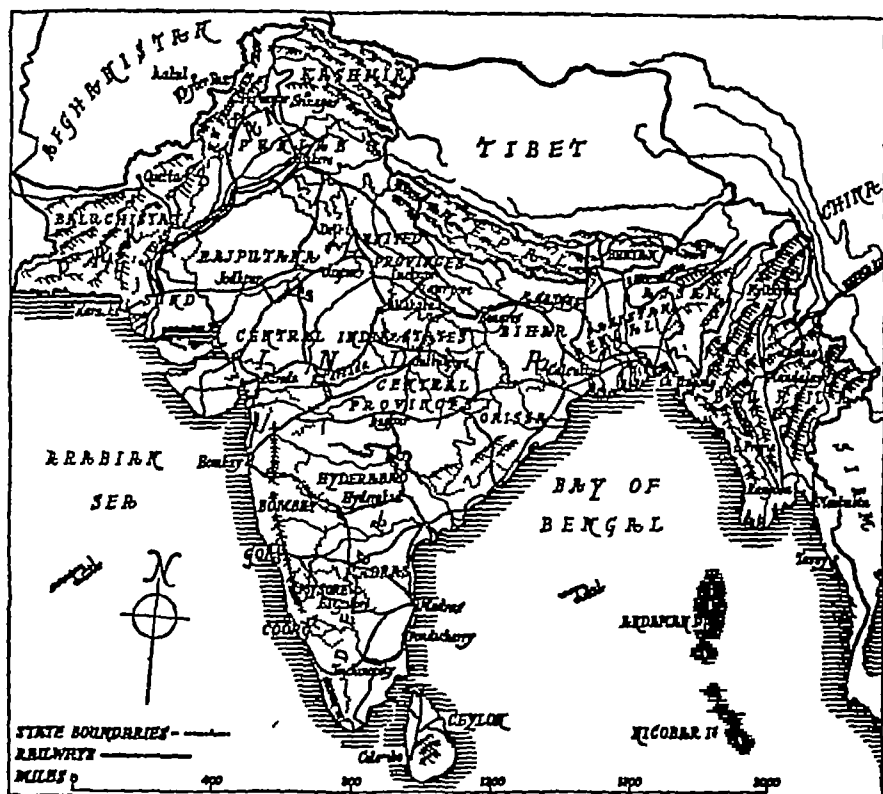
INDEPENDENCE, WAR OF.

The War of Independence was fought by the British colonists in the Thirteen Colonies in North America (1775-1783) They quarrelled with the British Government on the questions of taxation and the liberty to trade with other nations They refused to pay taxes levied by the British Parliament in which they were not represented One of the unpopular taxes was that on tea In 1773, ships laden with tea lying in Boston Harbour were boarded by fifty men disguised as Red Indians, the chests were torn open and the tea emptied into the harbour this was the famous episode of the "Boston Tea-party"

There was soon fighting between British troops and colonists, the latter found a splendid leader in George WASHINGTON On 4th July,



Adding the tea in the Boston Tea-party



Map of the new India, Pakistan, Ceylon and Burma

1776, the American Congress issued the famous Declaration of Independence—"that these United Colonies are, and of right ought to be, Free and Independent States—that all political connexion between them and the State of Great Britain is, and ought to be, totally dissolved"

War started with the Battle of Bunker Hill (1775) and ended with the surrender of the British general, Lord Cornwallis, at Yorktown (1781) In 1783, the British Government recognized the independence of the United States, and in 1789 George Washington became the first president Canada remained loyal to Britain throughout the war, and many loyal British colonists moved northward from the United States to find new homes there.

INDIA, former name of the peninsula of southern Asia, now divided into two countries, India and the Dominion of Pakistan There are many marked differences in race, language, religion and customs among its peoples Its population is over 388 millions, and it is separated from the rest of Asia by the great Himalayan mountain range extending from Baluchistan in the west to Burma in the east Mount Everest, the highest peak, rises to 29,141 feet The CLIMATE is of the monsoon type, and is hottest from May to June, when the monsoon breaks Most of India has no rain except in the monsoon period The Himalayan foothills are cooler than the plains, and Europeans migrate there in the summer In the north-west,

the Khyber Pass to AFGHANISTAN lies in a desolate region inhabited by tribes with flocks of camels, sheep and goats. The mountain region of Assam in the north-east is noted for the tea grown on the slopes of the Brahmaputra Valley.

The great plains drained by the Indus and Ganges are the most densely populated parts of all. There is little rainfall, especially in the west, but irrigation overcomes the water shortage in most areas. Rice, jute, cotton, wheat and millet are grown intensively.

Delhi, the capital of India, is an important route centre, but the largest town is Calcutta. Karachi, capital of Pakistan, is an airport and port for the Indus basin. The chief exports in the west are wheat and cotton from the Punjab. In the southern peninsula is the Deccan plateau, sloping to the west from the steep forested scarps of the Western Ghats. Cotton is grown on rich lava soil in the north-west, and rice on the coastal plains. Elsewhere millet is the chief crop. Madras on the east coast and Bombay on the west, are important ports. Bombay is also a manufacturing centre, important mainly for textiles and steel. Coal, gold and manganese are mined, but industry is comparatively undeveloped. In some areas the ancient art of metal-beating, carpet-making and carving are still carried on.

India is a vast land with one of the oldest civilizations in the world. The great religious teacher, BUDDHA, lived there about 500 years before Christ. About the time of William the Conqueror, Mohammedans invaded the country from the North and created a great Mogul or Moslem empire.

The East India Company trading there from 1600, becoming the supreme power upon the

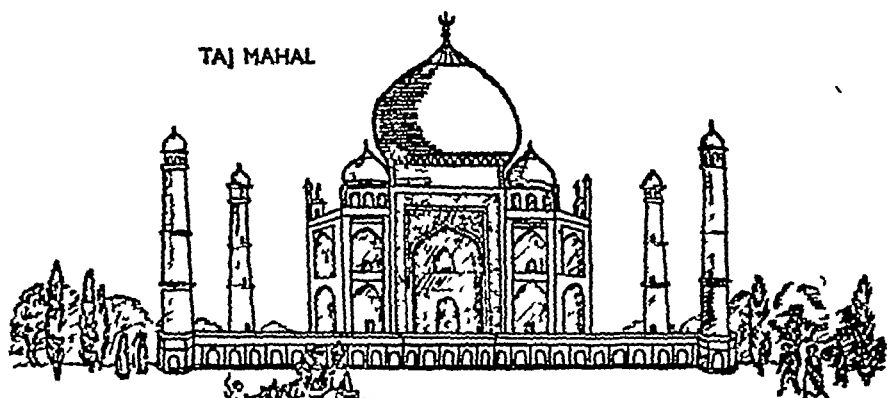
of CLIVE at Plassey in 1756 until 1859, after the INDIAN MUTINY. Then the British Parliament took over control of affairs and in 1877 Queen Victoria was proclaimed Empress of India.

As the Indian people became more politically minded, some Indian leaders, including Mahatma Gandhi, wished to bring British rule to an end and make India free of any political connexion with Britain. There are about 300 million Hindus there and about 100 million Moslems, besides other races. Hindu and Moslem leaders found it difficult to reach an agreement as to the future government of the country. Now the former India has become two countries, the predominantly Hindu state of India and the predominantly Moslem dominion of Pakistan, which is partly in the north-west and partly in the north-east.

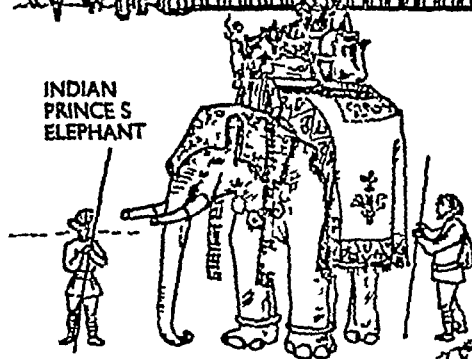
About 150 languages are spoken by the various peoples, without counting dialects. The people live mainly in villages, and work on the land. Methods of agriculture are still primitive, simple ploughs being slowly pulled by bullocks. Yet the splendour of their tombs, temples and statues is unequalled—the Taj Mahal at Agra, tomb of the wife of a former Mogul emperor, is world-famed. Only about 120 out of every thousand people can read or write, and owing to this fact vote by BALLOT is almost impossible in some districts. Yet with improving educational and welfare services, and especially with an increasing interest taken by educated women in public affairs, the new India and Pakistan now move forward with ever-increasing importance in world affairs.

INDIAN MUTINY broke out in 1857 when Indian soldiers, known as Sepoys, rebelled against

TAJ MAHAL



INDIAN PRINCE'S ELEPHANT



BULLOCK PLOUGH



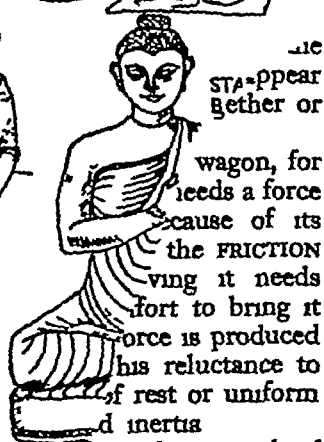
MARKET



SNAKE CHARMER

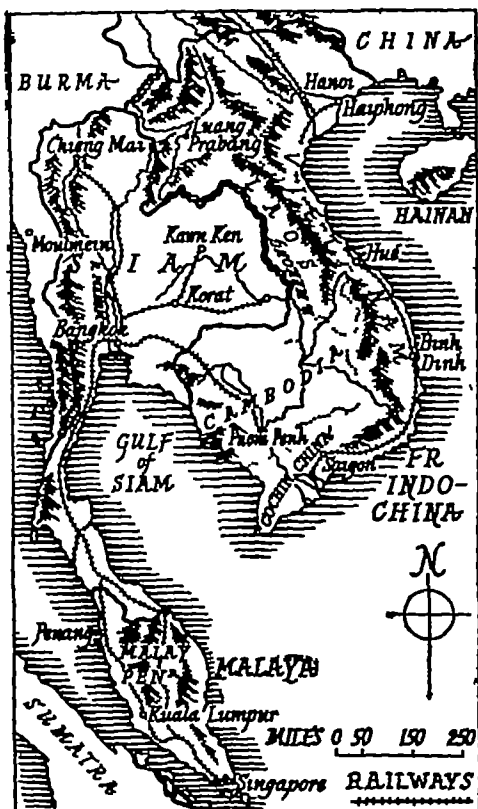


STAPPEAR BETHER or



wagon, for needs a force because of its the FRICTION ving it needs fort to bring it force is produced his reluctance to f rest or uniform d inertia is the spread of rity from one person

Some typical scenes from the vast land



Indo-China and Malaya

their British officers. There were three reasons for discontent: a false rumour that Indian religions were to be done away with, a prophecy that British rule in India, established in 1757 by the Battle of Plassey, would last only a century, and rumours that the cartridges given to the soldiers with the new Indian rifles were greased with 'pig and cows' fat, to the craftsman of which the pig is unclean and the cow is sacred.

History. A riot broke out at Meerut, one of the disturbances took place in the world. Cawnpore, and the teacher, Buddha, at Lucknow, 500 years before the siege. It was not time of William the Peace was common. Mohammedans in

from the North as the mutiny, the Mogul or Moslem took over the East India Company's affairs from there from 1600, by. See INDIA supreme power upon

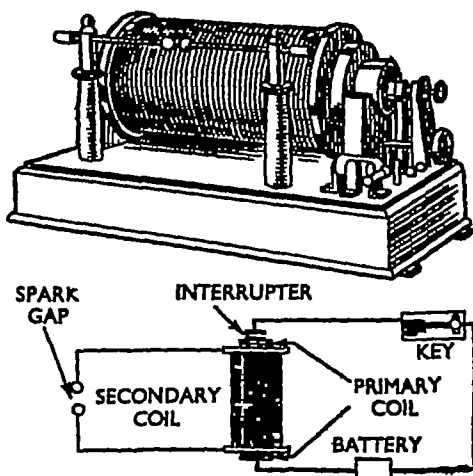
INDICES. See POWERS AND INDICES.

INDO-CHINA in the south-east of Asia includes the independent kingdom of SIAM, the French possessions of Indo-China (see FRENCH INDO-CHINA) consisting of Cambodia, Laos, Cochinchina and the republic of Viet Nam.

To the south is the Malay Peninsula.

INDUCTANCE COIL, a coil of wire which creates a magnetic field when a current passes through it. It may have an iron core. The effect of an inductance is to oppose any increase or decrease in the current passing through the coil, and thus it helps to keep the current steady.

INDUCTION COIL. A rapid change of current and magnetic field in one coil affects another coil near by, and induces in it a voltage. See MAGNET. The induction coil uses this principle to produce very high though intermittent voltages from a low voltage source of power, such as a battery or accumulator. The primary coil is magnetized every time a current passes through it from the battery, this current is constantly being started and stopped.



Induction coil and circuit

by the hammerbreak, which operates in a manner similar to an electric BELL. Every time the current is interrupted a high voltage is induced in the secondary coil, which consists of thousands of turns of fine wire wound round the outside of the primary coil. The high voltages so produced are used to make sparks across SPARKING PLUGS for engine ignition, X-RAY tubes and similar purposes, where little power but high voltage is required.

INDUSTRIAL REVOLUTION, the great change in the life and work of the British people brought about by the use of steam and the invention of machines for the factories.

Until the middle of the 18th century, spinning and weaving were done at home. New inventions, such as Kay's flying shuttle, enabled the weaver to use yarn more quickly than the spinners could prepare it. Then Hargreaves invented the spinning jenny which spun a number of threads at a time. Other machines followed, and became too heavy to be worked by hand. Water power was at first used. Small mills were built near streams, and in these the new spinning and weaving machinery was set up. Then came (1785) the steam ENGINE, improved by WATT, and the mills by the sides of streams were deserted, new mills and factories were built near the coalfields, where it was easy to obtain fuel for the engines.

Many people left the villages and went to the towns with the new factories and mills. The new machinery needed iron and steel, and the small iron works of Kent and other woodland districts (where iron was smelted with charcoal) could not supply enough iron. Then modern iron works sprang up near the coalfields. The popu-

lation of the North and the Midlands greatly increased, and new, unhealthy towns with crowded houses and slums amid smoke and dust became blots on the countryside. Conditions in the factories were bad for many years, until Factory Acts were passed to improve them. Before them children were forced to work twelve hours a day, crouching under machines, mending broken threads.

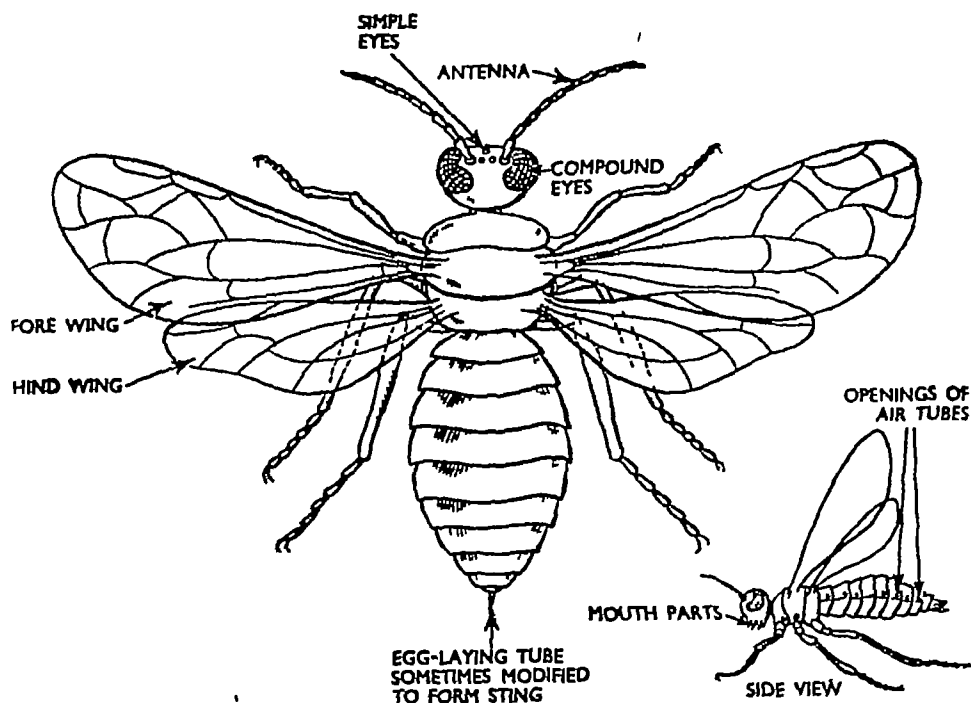
The coming of the machines caused hardship at first, and many workers feared unemployment. Bands of workmen sometimes broke into mills where new machines had been installed and destroyed them. These machine breakers were known as Luddites, from a weak-minded boy, Ned Ludd, of Leicestershire, who in a fit of temper destroyed some stocking machines.

Wedgwood developed the potteries, where cups and saucers are made. Famous engineers made CANALS, and others (Macadam, etc.) improved our roads. See TRANSPORT. Then in 1825 came George Stephenson's moving engine (or LOCOMOTIVE), and the age of RAILWAYS and steamships soon developed. Britain thus became the first industrial power in the world.

INERT GASES are a number of rare gas elements found in the ATMOSPHERE, which do not appear to be able to combine together or with anything else.

INERTIA. A railway wagon, for example, when at rest needs a force to set it moving, because of its mass, however small the FRICTION may be. Once moving it needs another force or effort to bring it to rest. This last force is produced by the brakes. This reluctance to change its state of rest or uniform motion is termed inertia.

INFECTION is the spread of bacterial activity from one person



A typical insect has six legs and sometimes one or two pairs of wings

to another, or the invasion by BACTERIA, causing putrefaction. Infection may be carried directly, or indirectly by flies and other insects. Diseases are called contagious when contact is necessary for their spread. Disinfection should take place after certain infectious diseases, the patient having a bath containing carbolic lotion, the bedding and clothing being washed in lysol solution, and rooms fumigated with formalin. Quarantine is the period of isolation necessary after exposure to infection.

INFRA-RED RAYS. These are often called "invisible light," because they usually accompany light waves given out by hot bodies and are reflected and refracted just like visible light. We cannot see them, however, because their wavelength is too great for the eye to be affected, but it is possible to take photographs in the dark of hot objects because of the infra-red rays they give out. The rays are

made use of in long-distance photography.

INK. Printers' ink is carbon black ground up in oils which dry very rapidly. Writing inks are other dyes dissolved in water. Invisible inks are numerous—an easy one to obtain is very dilute sulphuric acid. When used with a clean pen and blotted it is invisible, but on heating it turns black.

INOCULATION. Disease-causing BACTERIA produce poisons (toxins) in the body, and as a result the body forms anti-toxins to overcome them. Anti-toxins formed in the body of a person or animal against one particular disease can be injected into another person, and will help him to resist attack by bacteria of that disease. See PASTEUR. This inoculation is used generally to prevent, but sometimes to cure, the disease.

Vaccination is injection with the toxin itself, this produces a milder form of the disease which will give

immunity from the more serious one an example is the injection of calf-lymph, from a calf with cow-pox. Blisters develop at the points of injection, but the effect does not spread, and the vaccinated person is unlikely to catch the far worse allied small-pox if exposed to infection. This method of preventing the disease was discovered by the British doctor, Edward Jenner (1749-1823).

INSECT, the largest class of **ARTHROPOD** animals, including over 500,000 species. Insects' bodies are divided into head, thorax and abdomen. The head bears one pair of antennae, eyes and mouth parts. The jointed antennae are used for feeling, smelling and communication. The eyes are compound, unlike human eyes, and several small simple eyes may also be present. Mouth parts vary according to the insect's food, and may be adapted for biting, sucking, or piercing and sucking. The thorax is made of three segments, each bearing a pair of jointed legs, the last two segments usually bearing paired wings also. The abdomen bears no limbs but may have a sting, or in the female an egg-laying tube at the tip.

Insects breathe by a system of branching air-tubes, carrying air to all parts and opening by a series of holes down the sides. An insect hatches from the egg into a larva, which feeds, grows and moults a number of times. The full-grown larva becomes a pupa (compare with chrysalis under **BUTTERFLY**). From the pupa emerges the adult insect, which will grow no more. Some insects leave out the pupa stage, and the larva grows more like the adult at each moult. Some adult insects feed, other short-lived forms may not even have an alimentary canal. While many in-

sects are used by man—e.g. the hive-bee for honey and wax, the silkworm for silk, the cochineal beetle for dye—numbers of them do tremendous harm. The main orders of insects are considered under **BEE**, **BEETLE**, **BUG**, **BUTTERFLY**, **CADDIS-FLY**, **COCKROACH**, **DRAGON-FLY**, **FLEA**, and **FLY**. See also **METAMORPHOSIS**.

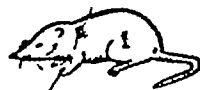
INSECT-EATING MAMMALS are a group of small **MAMMALS** with long snouts and sharply pointed teeth, which hunt their food chiefly by night. British members are the hedgehog, shrew and mole. The hedgehog's back is covered with short spines, its underside with coarse fur. If frightened, its defence is to curl itself into a tight ball with spines projecting and head and legs hidden. It hunts its food—grubs, snails, worms, eggs, etc.—by night, and may be heard grunting and snuffling. In captivity it enjoys bread and milk. (See **HEDGEHOG AS A PET**). Shrews resemble mice but are not related to them, they have more tapering snouts, minute eyes, pointed teeth and are also flesh-eating. Their fur, like that of moles, stands upright. They have a rank smell and many cats kill, but will not eat, both common and pigmy shrews. They make shallow burrows, but the tunnels of the mole are much deeper. Moles



HEDGEHOG



MOLE



SHREW

Common insect-eating mammals

have continually to hunt worms, or they would die of starvation in a very few hours. Moles throw up earth as mole-hills, shovelling with their amazingly strong spade-like forepaws. Their pin-head eyes are deep set in the grey-black fur, the ears also are concealed and the snout is long and sensitive.

INSECT-EATING PLANTS.

Certain plants are specially fitted to digest insects in addition to feeding in a way normal to plants. In Britain three small bog-living plants, sundew, butterwort and bladderwort, have specially modified leaves to trap insects. Glistening sticky drops on the red tentacles of the leaves attract insects. Small insects cannot struggle free, the tentacles bend slowly inwards and enclose them, while digestive juices make the soft parts of their bodies soluble, so that the leaf can absorb them. Butterwort

has leaves with curved edges, containing glands, while bladderwort lives in water and grows bladders with trapdoors opening inwards only, from its leaves. In both, small creatures are trapped.

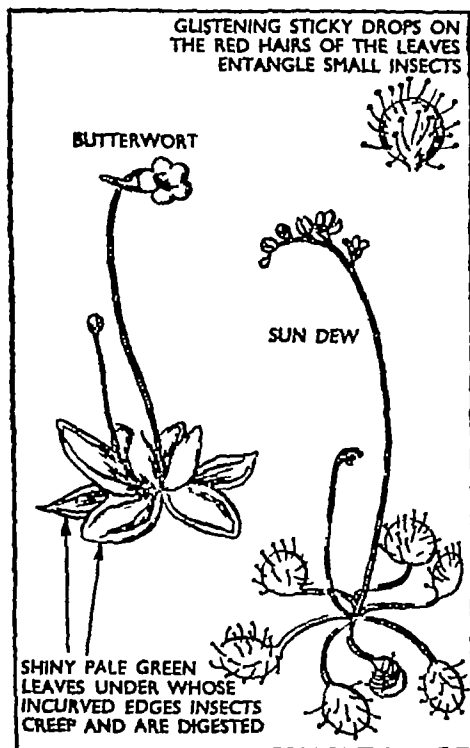
INSECTICIDE is a chemical substance which is used to kill unwanted **INSECT PESTS**. Common insecticides are pyrethrum, derris, nicotine, tar oil, formalin, and **D D T** (dichlor-diphenyl-trichlor-ethane).

INSECT PESTS wage a continuous war against the gardener's efforts to produce sound, healthy crops. To deal with them, first keep the soil clean and free from **WEEDS**, which harbour pests and aid their activities. If the growth of weeds is prevented by **HORING**, pests will not flourish, as the **SOIL** is exposed to the sun's rays which many pests dislike. Some of the most destructive pests are

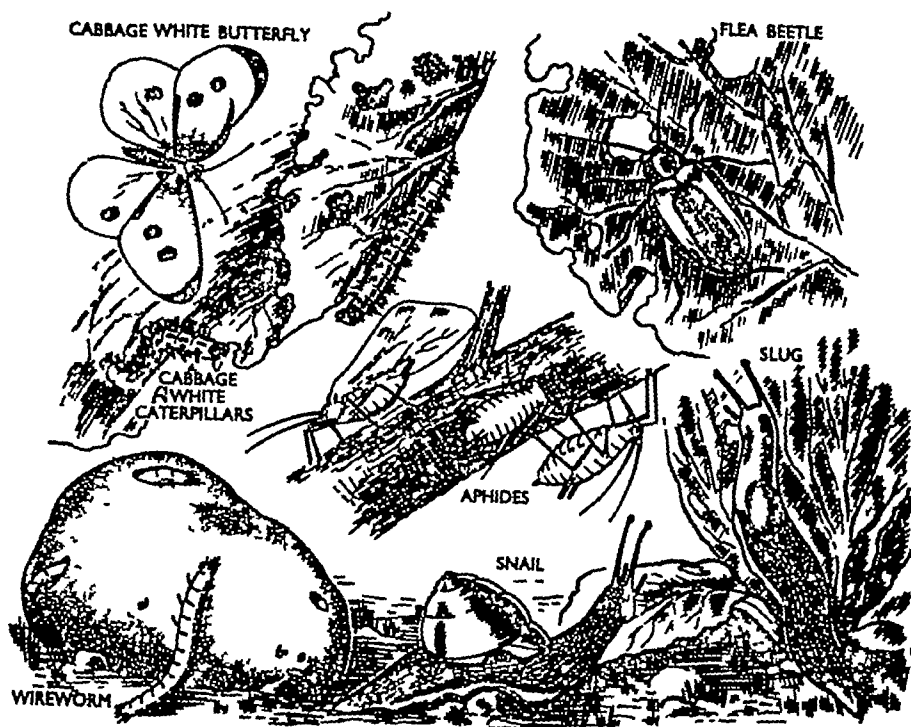
(1) *The Wireworm*, a very troublesome insect which damages potatoes, lettuces and seedlings. It can be trapped by burying bits of old potato or carrot in the ground at the end of a stick. The wireworm burrows into this trap which should be pulled up after a few days and burnt and another one set.

(2) *The Cabbage White Butterfly* lays its eggs on the leaves of the plants of the cabbage family during the late summer. These hatch out into green caterpillars in just over a week. Two methods of dealing with them are by picking off the caterpillars by hand and destroying them, or by spraying salt water into the centre of the plants.

(3) *Slugs and Snails* can completely ruin young lettuces. They come out from their hiding places under old walls, stones or heaps of rubbish in the evening, particularly if it is wet. A poisonous preparation called metaldehyde (meta) is very



Plants that eat insects



These insect pests are a nuisance in the vegetable garden

effective in dealing with these nuisances if it is spread around the plants to be safeguarded

(4) *Aphides* are tiny green or black flies which attack young cabbages, broad beans, rose and fruit trees. They can be controlled by dusting the plants with Derris powder, or spraying the trees with soapy water and paraffin mixed or with one of the special chemical solutions sold for the purpose.

(5) *Flea Beetles* attack seedlings of the cabbage family and young turnips, especially in the dry weather when the ground is hard. They are small, shiny, black insects that jump into the air when disturbed. Derris powder dusted on to the plants is very effective.

See GREASE-BANDING and INSECTICIDE

INSULATOR, a material of high resistance to the passage of elec-

tricity (see CURRENT), such as rubber, ebonite, asbestos, or earthenware, placed so as to prevent the wire carrying the current from touching any other conductors of electricity, it thus stops the electricity from flowing in unwanted directions.

INSULIN Diabetes is caused by a defect in the pancreas, so that it does not secrete enough of a substance needed to deal with the sugar absorbed in DIGESTION. This substance, called insulin, can be extracted from calves' livers, and, if injected into the diabetic patient's body, will replace that which should have been made by his own pancreas, and will thereby relieve his condition.

INSURANCE is a method of taking precautions against risks, whether to life or property. And risks such as accident, fire, theft,

loss, illness, and death are common Insurance companies have been formed to insure against these risks The procedure is similar in all cases If you wish to insure yourself against risks, you apply to the insurance company. If the company agrees to accept you, you are given a policy, which is a contract giving details of what you have to pay and what the company will do if that eventuality against which you insure takes place You can arrange to make your payments weekly, monthly or yearly. That payment is known as a premium If the eventuality never takes place, you have paid away premiums as a precaution, but if it does then the company will indemnify you for your loss

Then there is Social Insurance by the State for old age, ill-health and unemployment In 1908 Lloyd George introduced a scheme for old-age pensions In 1911 he introduced another measure of Social Insurance It was divided into two parts—health insurance, and unemployment insurance It was experimental in character The principle was that the premium should be paid by the insured person, his employer, and the State to cover (a) health insurance, which consisted of medical benefit, sickness benefit, disability benefit, maternity benefit and sanatorium benefit, and (b) unemployment insurance, for benefits during unemployment in certain compulsorily insured trades, and State help to trade unions which paid unemployment benefits From this slender beginning, growth has been immense The economist Lord Beveridge proposed a more comprehensive scheme of NATIONAL INSURANCE, and subsequently the British Parliament brought in a scheme to insure all workers against ill-health, accident

and unemployment, and affording money benefits or pensions to widows, the elderly, and disabled people, amongst others Governments of other countries are bringing in similar measures

INTEREST is a sum of money which falls due at stated intervals for the use of money lent. Interest is charged at the rate of so much per cent (per hundred pounds) per annum (per year) The money lent is the principal. When the interest is paid each time it falls due, it is called *simple interest*: it can be calculated from the following formula

$$\begin{aligned}\text{Simple interest} &= \\ \text{principal} \times \text{time in years} \times \frac{\text{Rate}}{100} \\ \text{or S.I.} &= \frac{\text{P.T.R.}}{100}\end{aligned}$$

So the simple interest on £4,500 for three years at 6 per cent will be

$$4500 \times 3 \times \frac{6}{100} = \text{£}810$$

When, however, the interest is not paid as it falls due, it is added to the principal: and this added sum of money itself begins to bear interest as additional money lent It is then known as *compound interest*, and calculated as follows: 1st year's interest on

$$\text{£}4,500 = 4500 \times \frac{6}{100} = \text{£}270$$

2nd year's interest on

$$\begin{aligned}\text{£}4,500 + \text{£}270 &= 4770 \times \frac{6}{100} \\ &= \text{£}286.2\end{aligned}$$

3rd year's interest on

$$\begin{aligned}\text{£}4,770 + \text{£}286.2 &= 5056.2 \times \frac{6}{100} \\ &= \text{£}303.372\end{aligned}$$

Compound interest = £859.572 = £859 11s. 5d correct to the nearest penny

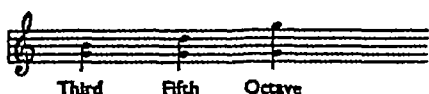
INTERJECTION. See GRAMMAR.

INTERMEZZO, a musical composition sandwiched in between two others, e.g. the well-known "Intermezzo" from *Cavalleria Rusticana*, which is played between two scenes of the opera

INTERNAL COMBUSTION ENGINE. See ENGINE

INTERNATIONAL DATE LINE. See **STANDARD TIMES** and also the map of the **WORLD**

INTERVAL. In music an interval is the difference in pitch between



Intervals between two notes

one note and another, e.g. G to B is a third, as it contains three notes, G A B, G to D is a fifth (G A B C D), G to G is an octave (i.e. interval of eight notes)—G A B C D E F G

INVAR is an alloy composed of 64 per cent iron, 36 per cent nickel. Its most valuable property is its negligible expansion when moderately heated. It is therefore used for surveyors' measuring tapes and for balance wheels of clocks.

INVESTMENT in commercial life is the use of money productively, so that a regular **INCOME** is obtained. If, for example, you have £1,000 to invest, you may do so in several ways. (1) You can invest it by buying ordinary shares in a **COMPANY**. You thus become part-owner of that company. From the profits you will receive a **DIVIDEND** or return on your investment or outlay. (2) You can buy a house. If the net return is good, that is, if after paying rates and taxes the remaining money from the rent of the tenant is high, you have made a sound investment. (3) You can invest in Government securities. You will generally obtain a smaller income, but it will have the advantage of being fairly constant and safe.

IODINE, a dark violet crystalline **ELEMENT** which is very soluble in alcohol, in which condition it is known as "tincture of iodine" and used as an antiseptic. Small amounts

are essential to all living animals. The sources of iodine are seaweed and crude Chile saltpetre.

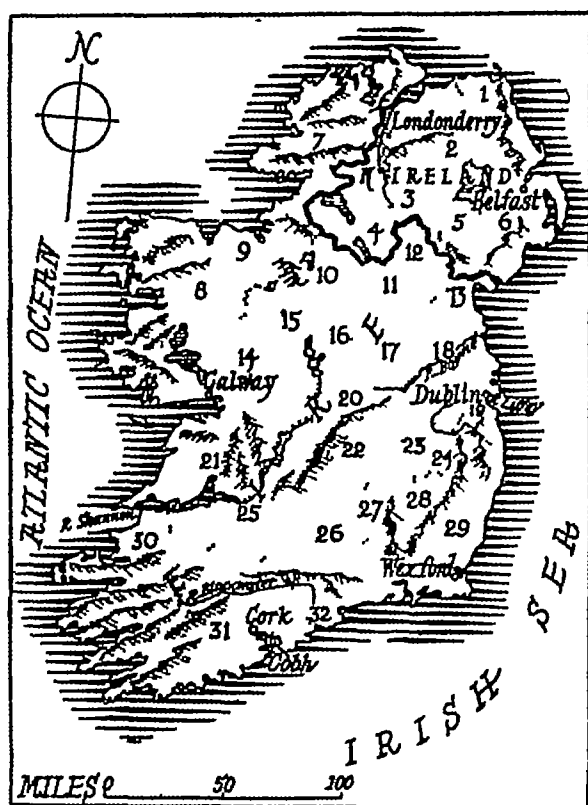
ION, the name given to the part of a molecule formed when it is broken up in solution or under electrical bombardment. Ions are usually electrically charged.

IRAN. See **PERSIA**

IRAQ (Mesopotamia) lies mainly around the basin of the Tigris and Euphrates, the only large rivers in south-west Asia, and at the eastern end of the Syrian Desert. Rice, wheat, barley and dates are grown, but the main source of wealth is the petroleum from the foothills of the Upper Tigris, sent by pipeline to the Mediterranean for export. The capital is Baghdad. See the map of the **NEAR EAST**.

IRELAND, the "Emerald Isle," so called because the grass remains green throughout the year in the mild, damp climate. The central plain is bordered by an irregular rim of highlands rising to mountains in the extreme south-west. In many parts of the plain, drainage is poor and huge swamps or bogs and large lakes occur. See **NORTHERN IRELAND** and **EIRE**.

History. After the **REFORMATION** the Irish remained Catholics. Later, Protestant settlers from Britain went to Ireland, settling mainly in the north. In Cromwell's time and again during the 19th century Ireland had a troubled history. Discontent was increased by famine in the 1840s; many Irish peasants emigrated to America, and a society known as Fenians hoped to overthrow British rule in Ireland and set up a republic. Outrages took place, but the Irish clergy never approved of the movement, and the majority of the peasantry were not much interested. For many years **GLADSTONE** tried to bring about some settlement by means of Land



The counties of Ireland are — **NORTHERN IRELAND** (1) Antrim, (2) Londonderry, (3) Tyrone; (4) Fermanagh, (5) Armagh, (6) Down, and **EIRE** (7) Donegal, (8) Mayo; (9) Sligo, (10) Leitrim, (11) Cavan, (12) Monaghan; (13) Louth, (14) Galway, (15) Roscommon, (16) Longford; (17) West Meath, (18) Meath; (19) Dublin; (20) Offaly; (21) Clare, (22) Leix, (23) Kildare, (24) Wicklow, (25) Limerick, (26) Tipperary, (27) Kilkenny, (28) Carlow, (29) Wexford; (30) Kerry, (31) Cork, (32) Waterford

Bills to help the peasants, and then by trying to secure Home Rule for Ireland

A bill to give Home Rule to Ireland was passed in 1914, but owing to threats of civil war between Northern Ireland (Ulster) and Southern Ireland, and the outbreak of the First World War, the plan was deferred. The Easter Rebellion of 1916 followed. This was the work of the Sinn Feiners who, like the Fenians, wanted a

republic. When elections took place in 1918, Sinn Feiners gained a majority and refused to take their seats in the Westminster Parliament, but set up an Irish Parliament in Dublin.

At last it was agreed (1921) to set up the Irish Free State excluding Ulster (Northern Ireland), which remains a part of the United Kingdom. It was to have the status of a dominion within the British Commonwealth, but this did not satisfy the Irish statesman, Eamon de Valera, and his Republican Party. After another civil war the Free Staters won and the Irish Free State began to rule itself. De Valera, Prime Minister 1932-48, gave the Free State a new constitution and used the Irish name *Eire* for the country. In 1949 *Eire* passed laws cutting its links with the British Commonwealth, to become the Republic of Ireland.

IRON is a white metallic **ELEMENT** notable for two things—its magnetic

properties, and the number of valuable **ALLOYS** which it forms with carbon and other elements.

It is found as an ore combined with oxygen or sulphur. The latter compound is occasionally found in household coal and is golden-coloured. It is called iron pyrites.

IRONS and IRONING. Household irons are of three kinds, *flat*, *gas* and *electric*. Flat irons are numbered according to weight. Nos. 1 and 2 being small and light are

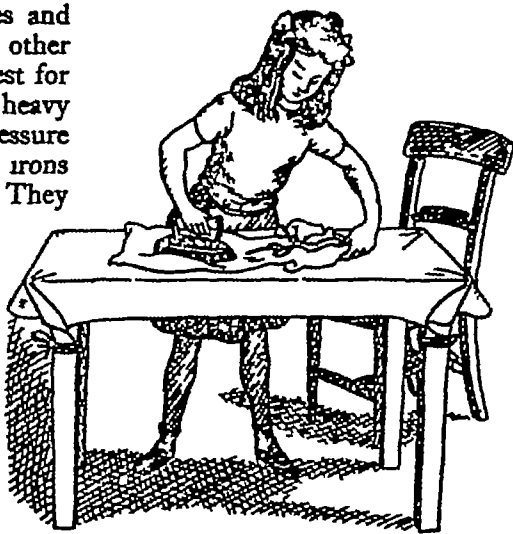
suitable for children's clothes and the more intricate parts of other garments, Nos 4 to 6 are best for general use, for they are heavy enough to give a good pressure without undue effort. These irons are heated over a gas ring. They must be kept clean with emery paper. Gas and electric irons maintain a uniform heat and only one iron is required, while with flat irons two are needed—one heating while the other is being used. Unless the electric iron has a thermostat to regulate the current, the current should be switched off when the iron is not actually being used. The heel of the electric

iron sometimes acts as a stand.

To test the heat of any iron dip a finger into a bowl of water and let a drop fall on to the face of the iron. If the iron is cool there will be no sound and the drop will roll off, but if the iron is hot there will be a sharp sizzling sound and the water will dry quickly.

The ironing table is prepared by spreading the ironing blanket smoothly over it. Place an ironing sheet over the blanket and fasten it by means of tapes to the legs of the table so that it does not crease. Have a basin of cold water ready, a damping cloth, the iron stand, and hangers ready for use. (With a patent ironing board, which conveniently folds up after use and can be put away, one side of a garment can be ironed without creasing the other side.)

Fabrics are ironed evenly damp or quite dry, according to what they are. Ironing household linen or cotton articles is done on the right side, crêpe-de-chine-finished or satin materials on the wrong side. Iron in the direction of the warp



Iron with a good, even pressure

threads, those running the length of the material, if possible, and from right to left. Give a good, even pressure and continue until the article is quite dry. For flat cotton and linen things, have them partly dry, place them on the table right side up and iron evenly until dry. For things not flat, iron the parts farthest away first, and small parts before the large parts. Iron lace and embroidery on the wrong side over a piece of flannel, and cover embroidery with a damp cloth. Hold gathers in the left hand, press the toe of the iron into the gathers, raising the heel of the iron. All garments should be hung on a rack to air before being put away.

Pressing is a special method of ironing, and is suitable for all dry materials and seams. The article is placed on the ironing table, the warm iron pressed lightly over a damp cloth on certain parts, lifted, and pressed again. Knitted fabrics are pressed on the wrong side. While a garment is being made, every seam should be pressed as it is finished.

IRRIGATION is a method of making up for lack of rainfall by watering the ground artificially. The water is generally obtained from rivers, wells or reservoirs. Primitive water-wheel and bucket systems are still used in places in Egypt, India and China, but dams have been built in Egypt and India which store river and lake water until the dry season, to be distributed then through canals and ditches. **ARTISIAN WELLS** (deep wells which collect water from water-holding layers of rock, such as sand or chalk, lying between two impervious layers) are also used. Many of these have been sunk in the London and Paris basins, the Sahara Desert and Australia.

IRVING, Sir Henry (1838-1905), was a famous actor-manager, particularly in tragedy. He became famous for his acting in *The Bells*. From 1878 to 1902 he managed the Lyceum Theatre with Ellen Terry, the actress. Irving did much to revive Shakespeare on the English stage.

ISAIAH, a Hebrew who lived in the 8th century B.C., taught that God governed all nations, and was holy and required righteousness and justice. He prophesied that Judah would suffer for its greed and wickedness, but a remnant would remain, and the ideal King, the Messiah, come. He wrote most of the first part of the book of the Bible that bears his name.

ISLAM, the religion founded by MOHAMMED.

ISLAND, a piece of land completely surrounded by water.

ISLE OF MAN, an island tourist resort in the Irish Sea which has its own ancient parliament, called the House of Keys. See the map of England on page 204.

ISOBAR, a line on the map joining places with the same atmo-

spheric pressure. See **BAROMETER**.

ISOTHERM, a line on a map which joins up places on the earth's surface which have the same average atmospheric temperature.

ISRAEL, the Jewish state formed out of the former **PALESTINE**.

ITALIAN ART. See **ART**.

ITALY is a Mediterranean country consisting of the main peninsula and the islands of Sicily and Sardinia. The peninsula consists mainly of the Apennine mountains bordered by fertile coastal lowlands which are watered by numerous small rivers. Between the Apennines and the Alps in the north is the broad Lombardy plain of the Po Basin. Wheat (from which macaroni and spaghetti are made), maize and rice are grown, and grapes and olives on the more southerly coastlands. Silkworms are reared on mulberry trees in the River Po basin, which supports half the population of Italy and is also the centre of a large textile and automobile industry (based on **HYDRO-ELECTRIC** power from the Alps), concentrated in a few big towns such as Milan and Turin. The chief ports are Genoa on the Ligurian coast, and Taranto and Brindisi in the south, which are air and sea ports on the route to the East. Rome, the capital, lies on the Tiber and is a world-famous artistic centre. Other well-known towns are Naples (famed for the nearby ruins of Pompeii), Florence, and Venice, an island city where canals often take the place of streets. The Italian Alps are famed for their lake and mountain scenery.

History Until the second half of the 19th century Italy was not a "nation", it was a "geographical expression". It was made up of a number of small states, some of which, especially Naples, were badly governed. At that time Venice and

Lombardy were still under Austrian rule. Mazzini, an Italian patriot, who had been driven into exile because of his political views, wrote in favour of an Italian revolt, and organized the Young Italy Association. But the man mainly responsible for Italian unity and liberty was Count Cavour, the Prime Minister of Sardinia-Piedmont. He secured the help of Napoleon III, the Emperor of the French, in a war against Austria. Lombardy was freed, but before Venice could be liberated Napoleon deserted the Sardinians (1860). Cavour and his king, Victor Emmanuel, worked on, and eventually the King of Sardinia became king of a united Italy.

A famous leader in this campaign was Garibaldi. He became acquainted with the leaders of "Young Italy." At the head of his famous "Thousand," volunteers of various nationalities, he sailed—under the protection of the British Navy—from Genoa for Sicily, made himself master of the island, and then crossed to the mainland. He drove Francis II out of Naples, and held the city until the arrival of Victor Emmanuel, who was proclaimed at Naples as King of Italy. Venice did not come into the new nation until 1866, some of the Papal States not until 1870. Thus Italy, like Germany, grew up very late as a united nation.



Map of Italy with the new frontiers

In the FIRST WORLD WAR, Italy fought against Germany, later Mussolini set up a Fascist Government in Italy, but did not depose the king. In 1935 Mussolini made war on the Abyssinian king, Haile Selassie, though both Italy and Abyssinia were members of the LEAGUE OF NATIONS.

Before the outbreak of the SECOND WORLD WAR Mussolini made an alliance with Germany, known as the Berlin-Rome Axis. Italy suffered severely during the war, and was defended by German troops. In September, 1943, the United Nations granted her an armistice, but German troops continued to fight in the north. The German forces in Italy finally surrendered in 1945 and Italy became a republic.

JACKAL See DOG

JACKDAW, a black BIRD with grey head and nape, resident in Great Britain. It is always to be found with rooks and gulls in autumn and winter. It nests sociably in trees, towers and ruins, and says "Jack! Jack!" It is easily tamed when young, but often steals. See CAGE BIRDS.

JACOB was the son of Isaac and twin brother of Esau. The book of Genesis tells how Jacob cheated Esau of his birthright and blessing, and then fled to his uncle Laban, and during the journey had a striking dream at Luz. After many years he returned and made up the quarrel with Esau by gifts. Continuing his journeying, Jacob came

again to Luz, where he had first dreamed. For this reason he built an altar, and renamed the place Bethel. Then Jacob's name was changed to Israel. The rest of Genesis tells the story of his sons, JOSEPH and his brothers, and of how Jacob finally went to live in Egypt, made Joseph promise to bury him in Canaan, and gave his prophetic blessing before his death.

JACOBITES. When King JAMES II left England in 1688 and William, Prince of Orange, became King of England, most of the people were pleased, but some were not. Those who thought James and the Stuarts should still rule the country formed themselves into a society called the Jacobites—from *Jacobus*, the Latin form of James.

In 1689 Graham of Claverhouse roused the Highlanders for James and won the Battle of Killiecrankie, but Claverhouse died at the moment of victory. Queen Anne's reign was one of constant plotting by the exiled Stuarts.

In 1715, soon after the accession of George I, a rebellion took place in favour of King James's son, known as the Old Pretender. This rebellion was soon over, and the rebels were treated with great mercy. Thirty years passed before another Jacobite rising occurred. Then Bonnie Prince Charlie landed in Scotland, and this Young Pretender became a popular hero. He collected an army together and marched south as far as Derby, but the rebellion ended in failure. The rebels withdrew to Scotland, and the following year (1746) the prince was defeated at Culloden, near Inverness, by the Duke of Cumberland (son of George II) whose



Prince Charlie's Jacobite army

treatment of the vanquished earned him the name of "the Butcher" Prince Charlie, aided by Flora Macdonald, escaped "safely o'er the stormy main," and there were no more Jacobite risings. Flora Macdonald was imprisoned in the Tower of London for her share in the escape of Prince Charlie.

JAGUAR See CAT

JAMAICA is the largest British island in the WEST INDIES. It is hilly and watered by several rivers with good harbours at their mouths. A number of the people are farmers, growing coco-nuts, spices, cereals and tropical fruits. Sugar, coffee and bananas are grown on big plantations. Jamaica is noted for its rum. The capital is Kingston. See map of CENTRAL AMERICA.

JAMES I (reigned 1603-1625) was the first of the Stuart kings of England. As he was also James VI of Scotland, he thus became the first king of the united monarchies. He was the son of Mary Queen of Scots, cousin of Queen Elizabeth, and when Elizabeth lay dying she named him as her successor.

James I took great interest in the splendid translation of the BIBLE known as the Authorized Version (1611). He was a believer in the divine right of kings—that the king was appointed by God, and to disobey the king was to disobey God. His reign became a preparation for the civil war during the reign of his son, Charles I. Important events of James I's reign were the GUNPOWDER PLOT (1605), the first successful British colony in Virginia (1607), the sailing of the PILGRIM FATHERS on the *Mayflower* (1620), and the development of overseas trade by the East India Company.

JAMES II (reigned 1685-1688) was the second surviving son of

Charles I. On the restoration of his brother Charles II to the throne, James returned to England also, and did good work as Lord High Admiral. In 1672 he became a Roman Catholic and on the passing of the Test Act, 1673, was obliged to give up his offices. After James's accession, a rebellion took place in favour of the Duke of Monmouth, but this failed and the duke was put to death. The king ordered a Declaration of Indulgence to be read in all churches, suspending the penal laws against Roman Catholics and Protestant Dissenters. Seven of the bishops refused to read it, and were tried but acquitted. The birth of a son to James's second wife, and the fear of a Catholic succeeding to the throne, led the chief men of England to invite James's son-in-law and daughter, Prince William of Orange and Princess Mary, to become king and queen. William landed in England in November, 1688. James fled to France with his wife and infant son. In 1690, he made another bid for the throne and landed in Ireland, but his army was defeated by William at the Battle of the Boyne, and he died in exile.

JAM-MAKING. The general rules for jam-making are: Fruit must be sound, ripe, clean and dry. Over-ripe or decayed fruit will prevent jam from keeping. Hard fruit is washed, soft fruit is put into a colander and water allowed to run through it while it is gently shaken. Afterwards it is dried in a towel. The sugar must be measured carefully, if too much is used the jam will crystallize, if too little, it will not keep. The average quantity is 1 pound of sugar to 1 pound of fruit. The preserving pan should be thick enough to prevent burning (aluminium is satisfactory), and the jam must be stirred constantly with

a wooden spoon while cooking All sugar should be dissolved before boiling begins Boiling should proceed steadily and briskly, for a time varying with the condition and kind of fruit

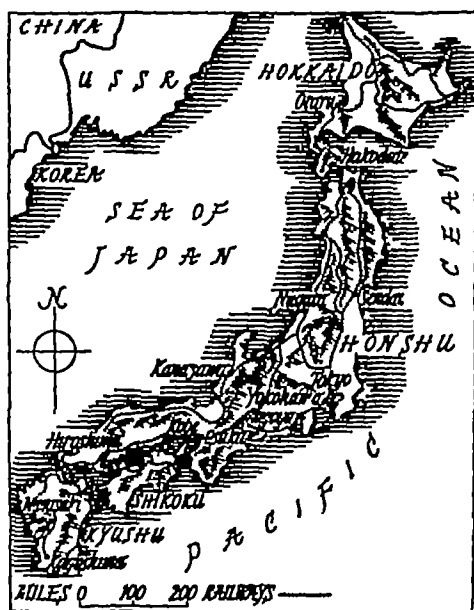
It is best to test the jam by pouring a little from the spoon on to a cold saucer, if it sets when cool, it is ready It should be poured into heated jars, soon after it is ready, to within $\frac{1}{4}$ inch of the top of the jar A round of waxed paper is placed on the surface of the jam, and then the jar is covered with a round of Cellophane Store in a cool, dry, well-ventilated place

The more expensive fruits can often be mixed with cheaper ones to make a more economical jam Thus blackcurrants, raspberries, or strawberries can be mixed with a smaller quantity of rhubarb Apples and blackberries make a good mixture Dried fruits such as apricots, figs, and peaches make delicious jam

JAPAN lies in the Pacific Ocean and consists of four main islands, Hokkaido, Honshu, Shikoku, and Kyushu, with mountainous interiors surrounded by coastal lowlands (Many of the adjacent small islands are inhabited by the Japanese) It is a country of earthquakes and volcanoes The climate is temperate The highlands are covered with forest and bamboo thickets, but in the lowland clearings of the south rice, tea, cotton and sugar are grown, and in the central districts, silk and soya beans About half the people are farmers and fishermen There are also large shipbuilding, silk and cotton industries, and Japan was famous for mass production of cheap toys Tokyo, the capital, and Osaka, the great manufacturing centre, both on Honshu, are the islands' chief towns

History For centuries ruled by emperors as a feudal state, Japan was industrialized about 1870 She defeated Russia's navy in 1904, and was allied with Britain in the First World War Ever since the latter years of the 19th century, Japan had been trying to expand at the expense of her Asiatic neighbours Her excuse for this was overcrowding of her own islands In 1895 she took Taiwan or Formosa from the Chinese, Karafuto from Russia in 1905, Korea from the Koreans in 1910, Kao-Chow from the Germans in 1914, the Mariana and Caroline Islands in the Pacific from the Germans in 1919 (when these islands were "mandated" to her), Manchuria from the Chinese in 1932, large provinces from the Chinese in 1937 onwards, and she occupied parts of French Indo-China in 1941

In 1940 Japan had signed a pact with Germany and Italy The following year the Japanese suddenly attacked the United States naval base at Pearl Harbour, Hawaii, and Great Britain and the United



The islands of Japan

States declared war on her. She captured Singapore from the British in February, 1942, she took the rich Malay colonies, and Rangoon (Burma) in March of the same year. But in May the Japanese invasion fleet was defeated in the Coral Sea, and again in the Battle of Midway. Island United States troops took Iwojima, 750 miles from Japan, in 1944. Rangoon was recaptured by the British in 1945, and in August of that year the first atomic bombs were dropped on the Japanese towns of Hiroshima and Nagasaki. On 15 August, 1945, the Japanese surrendered unconditionally.

JASON in CLASSICAL MYTHOLOGY is the leader of the ARGONAUTS in their quest for the GOLDEN FLEET.

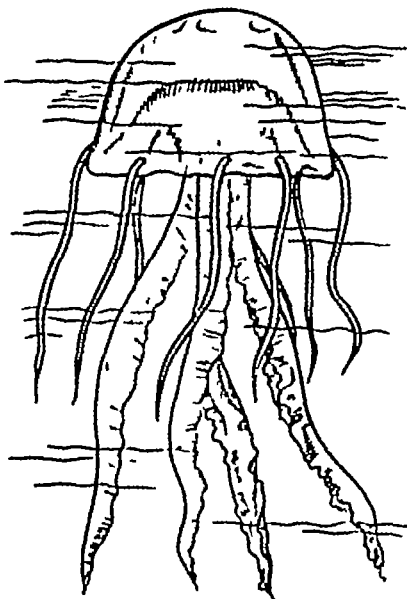
JAVA. See EAST INDIES.

JAY, a woodland BIRD resident in Great Britain. Its wings are short and show a flash of white and vivid blue on the brown plumage. It is a noisy bird, making a harsh "kraak."

JAZZ is the name given to the type of dance music, in current use today, which is built upon syncopation or disturbance of the normal accent. Jazz bands contain a variety of instruments, but especially favour SAXOPHONES and PERCUSSION instruments, TROMBONES, TRUMPETS (sometimes muted), VIOLINS, BANJOS, PIANOS and PIANO ACCORDIONS may all be added. A distinction is made between what is called the "rhythm" section and those instruments which play the melody. Jazz originated in the songs of the Negroes of America, and can be traced back to the savage races of Africa.

JEHOVAH, the English form of *Yahweh*, the Jewish name for God.

JELLY-FISH, a floating sea animal with a disk or bell of transparent tissue, and usually long



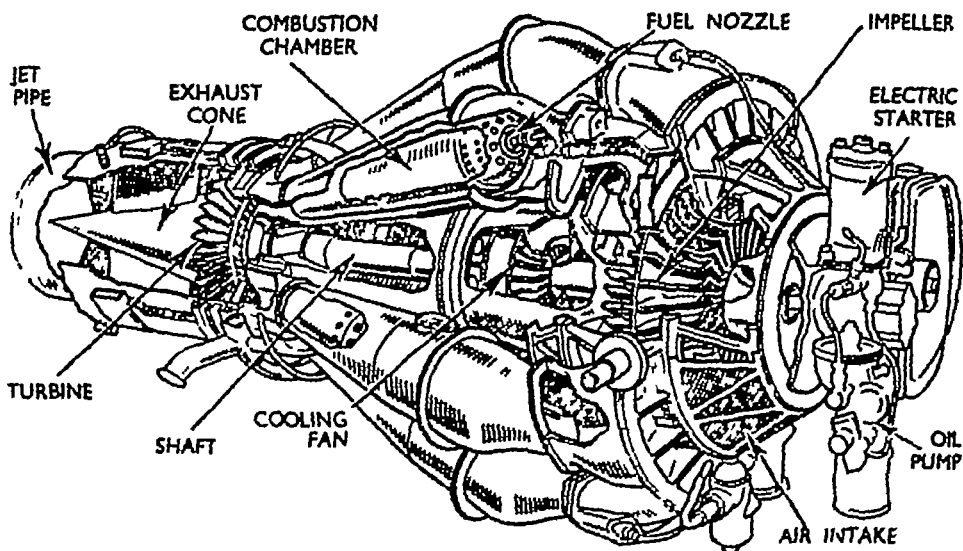
Jelly-fish with arms that sting

marginal tentacles and trailing "arms" set with stinging cells. These catch prey, which passes into the central mouth cavity. The sting of some types may be harmful to bathers.

JENKINS' EAR, WAR OF. In 1731, a British ship coming home from the West Indies was boarded by a Spanish man-of-war. The ship's cargo was stolen and the captain, Robert Jenkins, had his ear cut off. On arriving in England, Jenkins complained to the British Parliament, and war was declared against Spain.

JENNER, Edward (1749-1823), British doctor and the first man to practise vaccination, which is described under INOCULATION.

JEREMIAH began to prophesy in 626 B.C. and lived through the reigns of four kings of Judah. He was very courageous. Because he said that God would punish the sins of the people, and that Jerusalem would be captured, he narrowly escaped death, but he was



A continuous explosion inside thrusts the jet engine forward

beaten and put in the stocks and imprisoned during the siege of Jerusalem, which fell as he said it would

Jeremiah taught that God wanted good conduct first, not only trust in the Temple and sacrifices, for religion was trusting in God with the heart

JESUS CHRIST. The name *Jesus* means "Saviour" The title *Christ* means "the Anointed One" or "the Messiah" He was the founder of Christianity and, in Christian belief, the Son of God Born at Bethlehem of the Virgin Mary, wife of Joseph a carpenter, He grew up at Nazareth until at the age of thirty He appeared as a preacher and prophet with miraculous powers His story is told in the **NEW TESTAMENT**, the second part of the **BIBLE**

He taught people about God as the Father who loved all men, and told them He had come to start God's kingdom By His miracles and His way of life, He showed the power and love of God His stories and parables brought great crowds to listen During the three years of His teaching, He called disciples to

follow Him, those now known as the twelve **APOSTLES** being the most prominent The orthodox religious teachers of the day opposed Him as His teachings undermined their authority (See **MESSIAH**) Jesus warned His disciples that the Messiah must suffer and be crucified, and would rise again, but all this puzzled them, for they saw in Him an earthly king—long looked for by the Jews—as well as a religious leader What He had foreseen, however, happened The Jewish priesthood managed to get the Roman authorities who ruled their country to agree to His arrest, and His trial and **CRUCIFIXION** followed

His death is regarded by Christians as a sacrifice or atonement for the sins of mankind and the means of man's salvation (i.e. reconciliation with God) His followers tell how after three days Christ rose from the tomb and appeared to His disciples on several occasions so that they should be sure He had risen Finally He ascended into heaven Then, as charged by Christ, they went forth to establish the Christian Church and spread the story of His life and doctrines

JET ENGINE If we imagine a cylinder open at one end filled with an explosive gas, then the pressure from the explosion on the closed end of the cylinder will drive the cylinder in that direction. This is the principle of the jet engine, which is used to drive aeroplanes at high speeds. The explosive gas is made from oil and from air which has been drawn in and compressed by an impeller at the front of the engine. The explosions in the combustion chambers are made continuous and a constant stream of burning expanding exhaust gas flows smoothly over the exhaust cone and out of the jet pipe at the rear of the engine. As it flows out it drives a **TURBINE** which revolves a shaft for turning the impeller which is compressing the air at the front of the engine. It is important to realize that the jet engine is driven forward by the pressure of the exploding gas on the front inside surface of the combustion chamber, and its effect does not depend upon the presence of any dense atmosphere outside for the exhaust gas to push against. The jet engine is therefore superior to the propeller engine for flying at high altitudes where the air is extremely thin.

JEW was first the name for the people of the tribe of Judah, or the Southern Kingdom when Israel was divided after the time of Solomon. After the **EXILE** it became the name of all the nation. Later, in New Testament times, it was used for all who followed the law of **MOSIS** and the Jewish religion which developed from it. Since the time when the Romans captured Jerusalem in A.D. 70 the Jews have had no country of their own, but

have always looked to **PALESTINE** as their spiritual home, and still hold to their religion, and worship in **SYNAGOGUES**.

JIG, a guide on a machine for holding the material to be worked. If large numbers of exactly similar pieces of material have to be milled, drilled or otherwise machined, much time is saved if a jig is made and fixed to the machine in such a way that the material to be machined is automatically brought into the correct position.

JOAN OF ARC See **HUNDRED YEARS' WAR**.

JOHN (reigned 1199-1216), youngest son of Henry II, succeeded his brother Richard as King of England in 1199. His reign was a story of oppression and cruelty. England was placed under an interdict and the churches were closed by order of the Pope. John's reign is important, however, for the Great Charter (*Magna Carta*) which the Barons forced John to seal in 1215. In it certain feudal rights were guaranteed, London and other big towns were given special liberties, the constitution of a Great Council was laid down, justice was not to be sold, refused, or delayed, and no one might be kept in prison



King John signing Magna Carta

without trial, or suffer fine, imprisonment, or exile except by the judgment of his equals

JOHN, Don (1545-1578), son of the Emperor **CHARLES V** and half-brother of King Philip of Spain, drove the rebel **MOORS** out of Granada in 1570 and won a big naval victory at Lepanto against the Turks He defeated William the Silent, Prince of Orange, at Gembloux in 1577 and thus recaptured the southern provinces of the Netherlands for Spain

JOHN, St , a fisherman, born at Bethsaida in Galilee, became a close friend and disciple—perhaps the youngest—of **JESUS** He was present at the Transfiguration, the agony in Gethsemane, and the **CRUCIFIXION** After **PENTECOST** he visited Samaria with **PETER**, and preached in Asia Under Roman persecution, he was exiled to the isle of Patmos, but legend says that he died at Ephesus. The 4th **GOSPEL** and the three epistles which bear his name could have been written by him, but may possibly have been the work of someone else of the same name

JOHN O'GROATS is a popular name for the most north-easterly point of Great Britain

JOHNSON, Samuel, Dr (1709-1784), was the son of a Lichfield bookseller He was very poor, but married in 1735 Mrs Elizabeth Porter, a widow much his senior, and started a private school near Lichfield, which **GARRICK** attended The school was not a success, and Johnson went to London in 1737 where he managed to live by his pen In London his formidable personality and power as a conversationalist soon became known In 1738 his poem "London" appeared He issued the plan of his *Dictionary* in 1747 to Lord Chesterfield, soliciting his patronage, but meeting with



Dr Johnson loved conversation

no response. When the *Dictionary* appeared in 1755 Chesterfield wrote in its praise, to receive a public rebuff from Johnson In 1750 he started *The Rambler*, a periodical mainly composed of his own writings, which ran for two years In 1752 his wife died, and in 1763 he met young Boswell, a Scot, whose hobby was getting to know famous people and whose great work was to be the biography of his new friend Johnson presided over The Club, a gathering of notable people, including Reynolds the painter, Garrick and Burke In 1773 he toured Scotland with Boswell, and in 1777 he began *The Lives of the Poets*

His reputation is based on what he was, rather than what he wrote His wit, his sweeping assertions and his sound sense all live in Boswell's life of him, which, as biography, has not been surpassed

JOHN THE BAPTIST, St , the son of Zacharias and Elisabeth He lived in the desert and called people to repent and prepare for the coming of the Kingdom of God Many were baptized by him in the River Jordan, including **JESUS** John courageously rebuked Herod Antipas,

who imprisoned him and later put him to death at the request of Salome who had danced before Herod

JONSON, Ben (1572-1637), was both actor and satiric playwright, though his first occupation was that of bricklayer. He was frequently in trouble. In 1598 he was imprisoned, for killing a fellow actor in a duel. He became a Roman Catholic, but recanted twelve years later, and in 1605 was in prison for political offences. His *Every Man in His Humour* was acted with Shakespeare in the cast. From 1605 he produced at court a number of masques (see **DRAMA**) of considerable poetic merit. He wrote critical observations, collected under the title of *Timber*, which included a tribute to Shakespeare. He is buried in Poets' Corner in Westminster Abbey.

His works include *Every Man Out of His Humour*, *Volpone*, *The Silent Woman*, *The Alchemist*.

JOSEPH was the favourite son of **JACOB** and so hated by his brothers that he was sold by them to merchants who took him to Egypt. By his interpretation of dreams he won the favour of Pharaoh and became in importance second only to Pharaoh. During the years of plenty in Egypt, Joseph filled storehouses with corn, to provide for the years of famine which he knew would follow. When his brothers travelled thither to buy food, he disguised himself, but at their second visit he revealed his identity, and at Pharaoh's command he brought all his family to live in Egypt.

JOSHUA, the son of Nun, was the leader who came after **MOSES** to command the Israelites. When **Moses** died within sight of the Promised Land, Joshua led the people across the Jordan and captured Jericho and Ai, which he

followed up by other victories, though Canaan was only slowly conquered after the time of Joshua.

JOURNALISM consists of the writing and presentation of news, comment and opinion in **NEWS-PAPERS** and periodicals. The range of news presented is very wide and includes political, industrial and economic matters, crime, religion, amusements and sports, gossip concerning prominent people, and instructional articles for the home and for children. In addition to the general press, there are special magazines for women and for children, commercial, technical, trade and professional papers, religious, political, educational, scientific and literary journals.

See **PRINTING**.

JUDAS ISCARIOT was the **DISCIPLE** who kept the money bag for **JESUS** and the others and betrayed his Master to the Chief Priests for thirty pieces of silver. At the Last Supper, Jesus gave him the sop as an honoured guest and washed his feet. After betraying Christ with a kiss he repented, and took his own life.

JUDGE, an official well versed in law appointed to preside over a civil or criminal court. In U.S.A. the word is used as a title but not in Britain. In Scotland judges on appointment to the College of Justice (Court of Session) are called "Lord" followed by their surname or some assumed name. In England the chief judge is the **LORD HIGH CHANCELLOR**, leading dignitary of the law. There are many others, **Lords of Appeal**, the **Lord Chief Justice**, the **Master of the Rolls**, etc.

See **JUSTICES OF THE PEACE**, **LAW COURT**, **MAGISTRATE**.

JUGOSLAVIA lies along the Dalmatian coast of the Adriatic Sea, and consists mainly of the

Dinaric Alps and plains to the north. It was formed in 1919 from the former Serbia and Montenegro, and parts of the Austro-Hungarian Empire. Cereals, cattle and fruit are produced on the northern lowlands, where the capital, Belgrade, is situated. See the map of the BALKAN PENINSULA.

JU-JITSU, a form of self-defence, much practised in Japan. It consists of holds, based on the mechanical structure of the bones and joints of the human body, and falls, where use is made of the opponent's own weight and strength. A small person who is an expert can easily disable a much bigger opponent, but, naturally, practice is needed to obtain perfection.

JUNGLE, a low-lying forest with dense undergrowth, found in tropical regions such as the Sunderbans of the Ganges delta in India.

JUNO (Greek Hera) is wife of JUPITER and queen of heaven in CLASSICAL MYTHOLOGY.

JUPITER (Greek Zeus) is king of heaven and greatest of the gods who dwelt on OLYMPUS, according to CLASSICAL MYTHOLOGY.

JURY, a group of men and women who hear evidence in court in civil and criminal cases, and on the evidence given reach a verdict. In England there are twelve jurors in a criminal trial jury, eight in a civil county court jury, and their verdict must be unanimous.

JUSTICES OF THE PEACE (J P s) are men or women appointed by the Crown through the LORD HIGH CHANCELLOR to keep the peace within a certain town or county. To be made a J P is an honour, it is



Ju-jitsu trick—grab his arm and swing your leg back sharply to catch him behind the knee

not a salaried post. A J P grants LICENCES for the sale of intoxicating liquors. As a "judge," a J P deals with minor offences, breaches of the peace, petty theft, etc., and in some counties with juvenile delinquents. See JUVENILE COURTS, MAGISTRATE.

JUVENILE COURTS are special courts to deal with young offenders who are nowadays recognized to be in need more of curative treatment than punishment. They are presided over by not more than three magistrates or Justices of the Peace, of whom one at least must be a woman. They are less formal than the ordinary courts and are held in a different building or room. Many of the offenders are put on probation, that is, sentence is deferred for six months or a year with the prospect of their getting off if their behaviour during that period is satisfactory. Probation officers are officials whose work is to supervise offenders and help them to maintain good conduct. See also BORSTAL.

lands sugar, cotton and coco-nuts are grown The chief towns are Nairobi, which is the capital, Mombasa on the coast, and Kisumu on Lake Victoria See the map of AFRICA

KEY (in music) The two familiar **SCALES**, major and minor, can be commenced on a note of any pitch, and that note is always called the keynote, or tonic The key of a piece will take its name from the particular keynote commencing the scale out of whose notes that piece is made up See **SIGNATURE**

A key is also the lever by which the finger of a player makes an instrument with a keyboard sound, for example the **PIANOFORTE** and the **ORGAN**

KEYBOARD STRINGED INSTRUMENTS are musical instruments containing stretched wires which are plucked with quills or struck by tangents or hammers controlled from a keyboard The low notes have long thick wires, and the high notes short thin ones Early examples are the virginal, spinet, clavichord and harpsichord, and the latest example is the **PIANOFORTE**

KIDNEYS are a pair of organs situated near the backbone in the abdominal cavity Human kidneys are about 4 inches by $1\frac{1}{2}$ inches and dark red in colour Their chief function is to remove waste, containing nitrogen compounds and mineral salts, from the blood, and pass it down the ureters to the bladder This expands to hold the urine and is emptied at intervals About $2\frac{3}{4}$ pints of urine are excreted daily See also **ALIMENTARY CANAL**

KINETIC THEORY OF GASES If a "stink bomb" is dropped in one corner of a room, the smell will spread to every other corner This is because the gas **MOLECULES** from the bomb have travelled across the room Since nothing has pushed

them, we are forced to imagine them as always bouncing about like animated ping-pong balls They bump against the air molecules, which are themselves always on the move The **Kinetic Theory of Gases** explains not only the diffusion or spreading of the gas but also the pressure which it exerts in its expansion

KINGDOM OF GOD, also called the Kingdom of Heaven by St Matthew, who used that term because Jews tried to avoid using the holy name

God's Kingdom is God's rule in the lives of men **JESUS** preached about this, and told many parables about it It must be received as a gift from God, who is Head of the Kingdom

KINGFISHER, a fish-eating **BIRD** with long beak and short tail, often seen as a flash of brilliant blue darting along a river, or perched on a bough watching for fish It nests in holes on river banks See picture on page 77

KING'S EVIDENCE. When a person charged with a crime turns King's Evidence he agrees to give evidence against his associates in the crime in the expectation of receiving a lighter sentence himself

KINGSLEY, Charles (1819-1875), was a clergyman and Professor of Modern History at Cambridge He took a strong interest in the movement for social reform in the 'forties His children's books are well known, *The Heroes*, which tells the story of the **ARGONAUTS**, and *The Water Babies* He wrote historical novels, including *Westward Ho!* and *Hereward the Wake*

KINKAJOU. See **FLESH-EATING MAMMALS**

KIPLING, Rudyard (1865-1936), was born in India and worked there from 1882 to 1889, and it is for his books with Indian settings that he



Many of Kipling's stories and poems have an Indian background

is remembered Most of them are collections of short stories, *Plain Tales from the Hills*, *Soldiers Three*, *The Jungle Books* for young children, and, most famous of all, the novel *Kim* He presented early English history to children in story form in *Puck of Pook's Hill* and *Rewards and Fancies* *Just So Stories* is a collection of fantastic animal tales for children, and *Stalky & Co* a group of first-rate school stories for boys He also wrote a great deal of vigorous verse, much of it relating to the life of the soldier in India

KITCHEN GARDEN, the part of the garden where vegetables, salad crops and herbs for use in the kitchen are grown See ALLOTMENT GARDENING and VEGETABLES

KITCHEN MEASURES When scales and weights are not available certain domestic measures may be used Since, however, cups and spoons are not always of the same size, it is a good plan to keep for the purpose those which hold the required amounts *Liquid measures* 1 teacupful = $\frac{1}{4}$ pint, 1 breakfastcupful = $\frac{1}{2}$ pint, 1 tumblerful = $\frac{1}{2}$ pint *Dry measures* 1 tablespoonful = 1 ounce, 1 dessertspoonful = $\frac{1}{2}$ ounce, 1 teaspoonful = $\frac{1}{4}$ ounce, 1 level teacup = $\frac{1}{4}$ pound, 1 breakfastcupful = 7 ounces, 2 tablespoonfuls breadcrumbs = 1 ounce, 1 tablespoonful jam or treacle = 2 ounces, piece of butter size of small hen's egg = $1\frac{1}{4}$ ounces, piece of butter, size of walnut = $\frac{1}{2}$ ounce, 6 ordinary-sized lumps of sugar = 1 ounce Rice, suet, sugar, and similar foods are measured level with the rim of the spoon Flour and such light foods are heaped up as high above the rim of the spoon as the depth below it

KIWI, a New Zealand flightless bird, now nearly extinct The tiny wings and tail are hidden beneath feathers The long, curved beak is



Kiwi, now almost extinct

used to probe for worms Kiwis nest in burrows

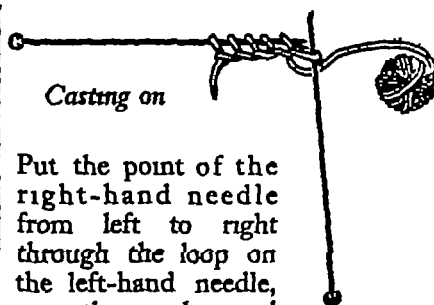
KNIGHTHOOD. Under the **FEUDAL SYSTEM** in England after the Norman Conquest (1066), a knight was a man holding land worth £20 a year (a knight's "fee") on condition that he rendered military service In the Middle Ages a knight was expected to represent the ideal of chivalry—to fight for the right, to help the weak, to honour womanhood Knighthood came after long training A boy started as a page in the household of some nobleman, at fourteen he became a squire, and until he was twenty-one he followed his lord to battle or in the hunting field Then, if he was judged worthy, the young squire became a knight, and was girded with a sword, either by the king or some great lord During the night preceding the ceremony, the sword lay before the altar of a church, and the knight-to-be kept watch until dawn At the ceremony he was dressed in his coat of mail, girded with his sword, and his spurs were fastened to his heels He swore that he would always guard the helpless and would, if need be, give his life for the Christian faith

During the CRUSADES two great orders of knighthood came into being the Templars, who were soldier-monks, whose object was to protect pilgrims to the Holy City of Jerusalem, and who had a house near the site of the Temple, hence their name, and the Hospitallers, or *Knights of St John of Jerusalem*, who cared for the sick and poor pilgrims. Another famous order of knights—the Order of the Garter—was founded by Edward III.

There is also the modern title, conferred by the King on those who have rendered service to the community this gives the recipient the honour of prefixing "Sir" to his name.

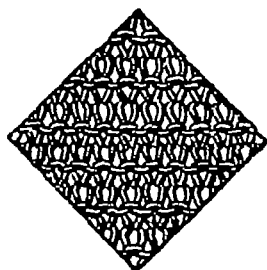
KNITTING is one of the most popular crafts and a knowledge of the elementary knitting stitches enables us to follow patterns and make a wide variety of garments and articles.

To cast on, make a loop on the needle in the left hand, tightening it so it that just fits the needle

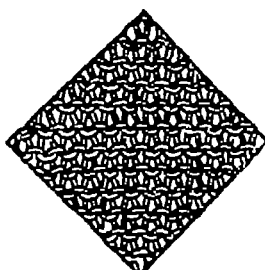


Put the point of the right-hand needle from left to right through the loop on the left-hand needle, pass the wool round the point of the right needle, and draw it through the loop. This makes a loop on the right needle. Slip this on to the left needle, and draw the right away. Repeat for the number of stitches required.

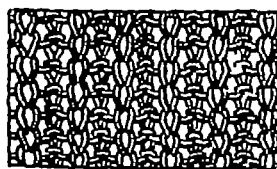
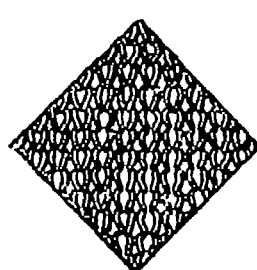
Plain knitting or garter stitch For the first row, hold the needle bearing the stitches in the left hand, pass the point of the right needle from left to right through the first loop, pass the wool round the point of the right needle, and draw it through the loop, making the first loop on the right needle. Pass the loop which has been used off the



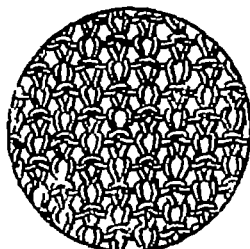
PLAIN OR GARTER STITCH



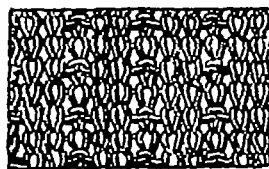
PURL SIDE—STOCKING STITCH—PLAIN SIDE



RIB OF 1 PLAIN 1 PURL



MOSS



FANCY RIB

Varieties of stitch in knitting

left-hand needle It will drop to form the fabric

For stocking stitch, the first stitch should be slipped on to the right-hand needle instead of being knitted This gives a neat edge which can be sewn flat

Purling Bring the wool to the front of the work Pass the point of the right needle from right to left through the first stitch The point of the right needle will be to the front of the work Take the wool over the point of the right needle, draw it through the loop to make a new stitch and pass the old loop off the needle

Rows knitted entirely of plain or purl stitch look the same, as one stitch is the reverse of the other

Stocking stitch This is made by working plain one row and purl the next, or, in circular knitting, using four needles, by working plain throughout

Ribbing Knit, say, two stitches plain, and two purl to the end of the row alternately Repeat this first row so that the stitches purled before are plain and the plain stitches purled For a ribbing of two plain and two purl, the number of stitches in the row must divide by four Ribbing can be varied by knitting and purling different numbers of stitches, say knit three, purl one, or knit one, purl three

Fancy ribbing is made by introducing a plain stitch into the purl section of the rib

Moss stitch Cast on an uneven number of stitches and knit a row of knit one, purl one, ending with a knitted stitch Keep repeating this row

Spider stitch Knit very loosely and wrap the wool twice round the needle instead of once

Plain or purl knitting gives a soft ridged surface, and is mostly used for babies' underclothes

Stocking stitch gives a flat smooth surface on the right side and a ridged one on the wrong Ribbing is an elastic stitch, it is useful for welts, cuffs, vests and children's underwear Moss stitch gives a strong close texture Spider stitch gives a loose web

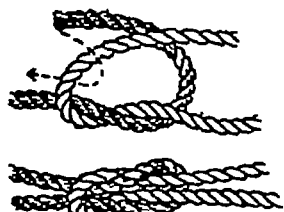
To cast off, knit two stitches, pass the first over the second and also off the point of the needle Knit another stitch and pass the stitch already on the needle over this and off the point of the needle Repeat until all are used but one stitch, then cut the wool and draw it through the remaining stitch Draw it tight and fasten in the end

To increase the number of stitches, knit in the usual way through the front of a stitch, then knit through the back of the same loop before passing it off the left needle Two stitches will be formed To decrease knit two stitches together Do not decrease right at the end of a row or an uneven ugly edge will be formed

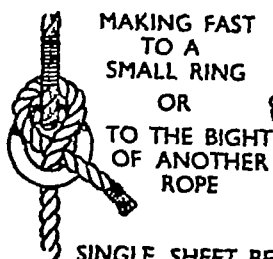
Stockings are generally knitted on four needles divide the total number of stitches required evenly on three needles—the fourth needle is the working needle

Knitting patterns can be bought for a large variety of garments When following a pattern use the correct size of needles and thickness of wool, and make sure the tension (number of stitches to 1 inch) is right, according to the instructions If too many stitches result, use slightly thicker needles, if too few, finer needles

KNOTS. There are many knots that can be made with ropes, and it is important to know when a particular knot should be used A reef knot is used to join the ends of ropes of the same thickness The single sheet bend joins a rope to a



REEF KNOT



SINGLE SHEET BEND

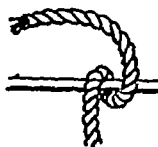


SHEEP SHANK

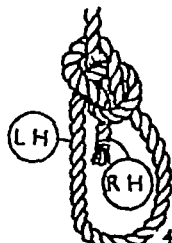
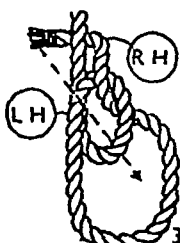
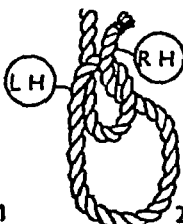
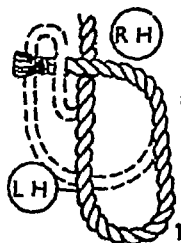


MAKING FAST
TO A
LARGE RING

ROUND TURN AND
TWO HALF-HITCHES



CLOVE HITCH



BOWLINE

Useful knots for various purposes

small ring or to a rope of larger thickness A round turn and two half-hitches join a rope to a large ring A bowline is for making in the end of a rope an eye which will not slip A clove hitch secures a rope to a rail A sheepshank shortens a rope fixed at both ends by taking up and securing the slack in the middle You must practise these knots with an odd piece of string or rope until you can do them automatically Then when the time comes to use them, you can ensure making knots that will remain fast

KNOX, John (1505-1572), was a great Scottish religious reformer When Mary I became Queen of England he joined CALVIN at

Geneva, but returned to Scotland in 1559 to spread Calvin's teaching He led the Scottish Reformers with such effect that before his death PRESBYTERIANISM was firmly established as the faith of most of the Scottish people

KOALA See POUGHED MAMMALS

KOREA is a country on a peninsula of the Chinese mainland The people are mostly farmers and fishermen Rice, barley, soya beans, cotton and silk are also produced Korea, once independent, was annexed by Japan in 1910, and remained a Japanese possession until 1945, when it was occupied by Russian and American troops See the map of CHINA

KUWAIT. See ARABIA



LABORATORY, a room or building specially equipped for scientific experiments

LABRADOR is a cold area on the Canadian mainland controlled partly by NEWFOUNDLAND, it is a region of old rock and poor soil. The people are mostly Eskimo trappers and fishermen. See the map of CANADA and p 477

LACROSSE is a ball game between two teams of twelve players, each player having a crosse, a wooden stick with a net at the end. The ball of india-rubber sponge is 8 inches in circumference. There are two goals each 6 feet wide and high placed at either end of the field, which is 100 to 130 yards between the goals. Side boundaries are agreed upon before the match, generally 80 yards apart, and players may go behind the goals. The object is to get the ball into the opponent's goal, the side scoring most goals winning. The ball is caught



Crosse

and carried in the crosse, and thrown from one player to another. Players may be tackled when they have the ball, either being charged with the shoulder or intercepted with the crosse. When a foul is committed the referee blows a whistle and all players must immediately stand still until the referee signifies that play can be re-started. The game lasts for two periods of thirty to forty-five minutes each, ends being changed at half-time.

It is a very popular game in Canada, and was originally played by the Red Indians.

LADYBIRD. See **BEEBLE**

LA FONTAINE, Jean de (1621-1695), French poet, writer of some delightful *Fables*, short satirical poems about animals, with a moral.

LAGOON, a stretch of water fringing the coast but separated from the sea by a spit of land made of material carried by tidal currents, if there is no outlet from a lagoon it will eventually become a salt marsh. Lagoons occur west of the Rhône Delta and round Venice, and on the Baltic coast. They are also formed by **ATOLLS**.

LAKES generally occur in **RIVER** valleys or in hollows on the earth's surface. **VALLEY** lakes may have been formed where **GLACIERS** have eroded the floor unevenly, or deposited morainic material which forms a dam. Surface hollows occur where an irregular mass of drift has been deposited by a retreating ice-sheet as in Finland. Smaller lakes include tarns or corrie lakes in glaciated areas, and crater lakes in the craters of extinct **VOLCANOES**.

LAMB, Charles (1775-1834), was born in the heart of London, in the Inner Temple, and all his life he loved London and its crowds. In 1782 he went to Christ's Hospital, where he first met his life-long friend, the poet Coleridge. His schooldays are recalled in his essay, *Recollections of Christ's Hospital*. In 1792 he became a clerk in the East India House, a post he filled for thirty-three years.

When he was twenty-three Charles Lamb had the full weight of family responsibility to bear, his father was ailing, an aunt, who lived with them, was dying, and his sister Mary suffered from occasional fits of insanity, while his brother John, though helping

financially, declined to do more. In 1799 Charles and Mary, left alone, made a home together, for he refused to be parted from her, except when an attack made it necessary for her to leave him until it had passed.

Lamb, sociable by nature, had a very large circle of friends, including most of the celebrated writers of the time. His literary work began with essays contributed to newspapers. With Mary Lamb he told in prose form the stories of twenty of Shakespeare's plays, Mary actually being responsible for most of the *Tales from Shakespeare*. He also wrote some critical essays on the plays of the lesser-known Elizabethan dramatists.

The Essays of Elia, by which he is best known, are full of personal charm and lively humour with occasional touches of pathos. His readers are quick to love the humanity in him. "Elia" was Lamb's pen-name—actually the name of a fellow-clerk in the East India House. In 1825 he retired on a generous pension. Brother and sister are buried in the same grave in Edmonton churchyard, Mary having survived him by some thirteen years.

LAMP Every lamp is a device in which fuel may be safely burnt so as to produce a steady light.

The oldest type is the *oil lamp* of which the old-fashioned wick lamp is the usual example. Here the oil rises up a wick by CAPILLARY ACTION and burns with a yellowish flame. But there is a modern variant in the *oil incandescent lamp* in which the oil is vaporized, mixed with air, and made to burn so as to make a mantle composed of special fire-resistant materials white hot or incandescent.

The *gas lamp* depends upon a supply of coal gas. This gas is mixed



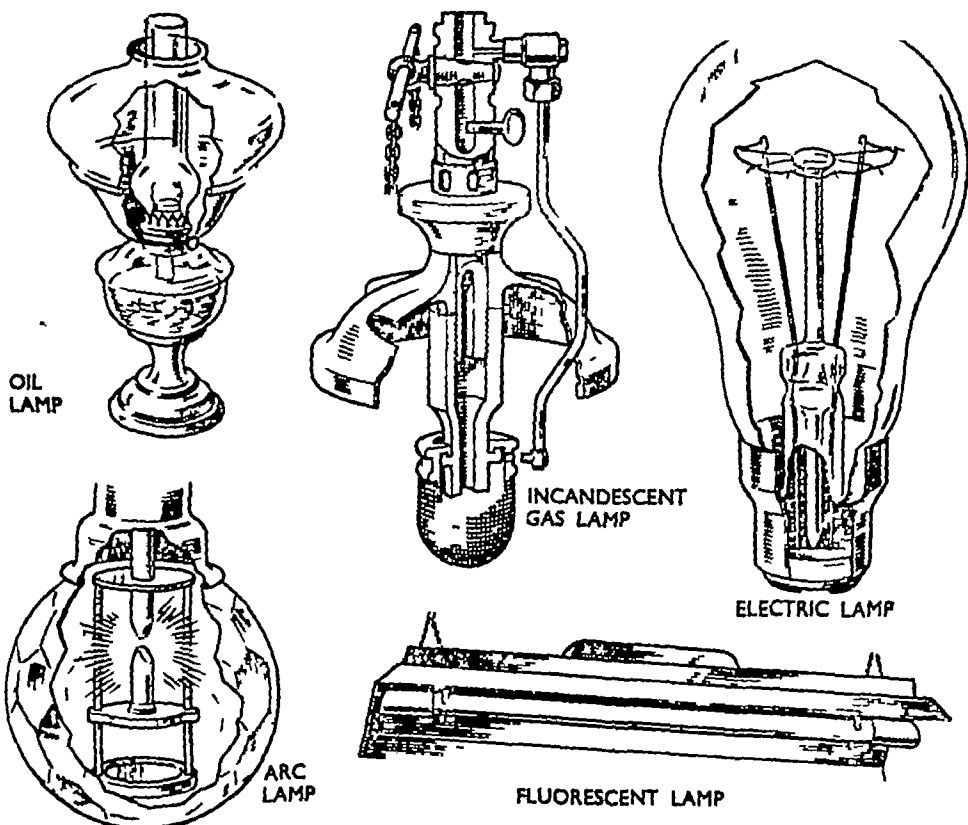
Charles Lamb, essayist

with air as it reaches the outlet in the lamp and, if the mixture is properly constituted, it burns with a hot flame which quickly makes a GAS MANTLE incandescent.

Electric lighting has long made us familiar with the *electric glow lamp* or *bulb* in which the light comes from a filament of wire which is made white hot by the passage of an electric current. The wire is nowadays of tungsten, which has a very high melting point. The glass bulb, empty of air, is usually filled with an inert gas at low pressure. This has the effect of hindering the filament itself from being burned away.

Another form of electric lighting is the electric *arc lamp*, in which the passage of current between two carbon electrodes makes the carbon white hot, thus creating an intense light. The arc lamp is used in CINEMATOGRAPHIC PROJECTORS and searchlights, stage-lighting, etc. As the carbons slowly burn away they are pushed towards each other either by hand or by automatic means.

A new type of arc lamp becoming very popular is the *fluorescent lamp*.



Lamps showing the development of illumination

This depends on the passage of an electric current through a gas in a long glass tube, which is coated with a substance which fluoresces or glows brightly under the impact of the electrically charged gas. Though first introduced for decorative lighting, these lamps are now being used more and more for illumination.

LAMP-BLACK (carbon black) is a special kind of soot made by burning an oily flame in air insufficient to ensure complete combustion. It is used in the manufacture of ink and to increase the hardness of motor tyres.

LANDSCAPE GARDENING is the art of planning the general layout of the features comprising a garden, such as the LAWN, paths, flower beds, ROCK GARDEN, ornamental pools, steps and walls, etc.

LANDSCAPE PAINTING.

Many of the pictures one sees in an art exhibition today are pictures of fields, trees and hills, of lakes, rivers, sea and skies. These are called *landscapes*, and are probably the most popular type of picture.

Landscape painting is a comparatively new art. We do not find many pictures of landscape alone before the 17th century. Before this time, landscape had only been used as backgrounds or settings for figures. Dutch painters, such as Hobbema and Ruysdael, however, made real landscape pictures, and they were soon followed by the English artists, who found their own climate excellently adapted to this subject owing to its fine atmosphere and interesting changes of light. Constable was one of the greatest. See also ART.

The Impressionists revelled in realistic treatment of out-of-doors subjects, and were particularly interested in the changing effects of light and weather in the countryside See IMPRESSIONISM

LAND'S END is a granite headland in Cornwall marking the most south-westerly point of England

LANTERN, MAGIC, a metal box in which a light from a lamp passes through a condensing lens, then through a partly transparent picture or "slide," then out through another lens to form an enlarged image of the picture on a distant white screen

LARK, a small meadow BIRD The cock bird sings as it slowly rises, flying up until it appears a minute speck in the sky Its twittering song is also uttered from perches Larks nest in the meadow grass and on heaths and moorlands

LATENT HEAT is the heat energy needed to melt a solid or boil a liquid These changes take place without any appreciable change of temperature, as the heat is all used up in giving the MOLECULES the energy necessary for their new state One gram of ice

turning to water at 0 deg C uses up 80 CALORIES, while the same weight of water turning to steam at 100 deg C uses up 540 calories

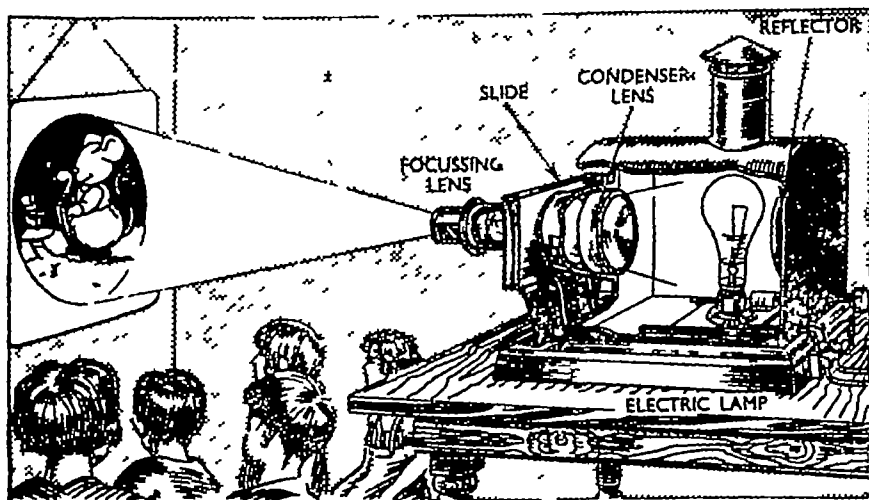
LATEX is the crude pure RUBBER liquid, a thin milky fluid which flows from cuts in the rubber tree It is clotted chemically and turned into solid crêpe rubber

LATIMER, Hugh (about 1490-1555), was a Protestant bishop and martyr during the REFORMATION, who was burnt at the stake at Oxford with Bishop Ridley in the reign of Mary I He was a famous preacher, and his sermons are among the earliest important literary works of English Protestantism

LATITUDE. See MAP

LATVIA, a small Baltic state, was in 1940 incorporated in the Union of Soviet Socialist Republics See map of SCANDINAVIA, near which it lies The capital is Riga The land is flat and marshy, and there are numerous lakes and forests

LAUGHING GAS, nitrous oxide, the first gas to be used as an ANAESTHETIC to produce sleep in dental and other operations, is so called because small doses of it make a person giggle



Magic lantern projecting a slide on to a screen

LAUNDERING is washing and ironing clothes. Different materials require different methods, so first sort them out as follows—cottons and linens, rayons and silks, woollens.

White and colour-fast cottons and linens are soaked for fifteen to thirty minutes in luke-warm suds, wrung out and then washed by squeezing in well lathered warm water. They should be rinsed till clear in at least three lots of water, white clothes should be dried in the sun.

Printed cottons and linens not fast colours are not soaked but washed quickly in well lathered luke-warm water. Rayons and silks should be washed in luke-warm soapy water, they should be squeezed, not rubbed, under the water to prevent stretching the garment while wet, three rinsing waters should be used.

Chamois leather, woollen, cotton, and silk gloves may be washed. Kid and suede gloves are dry-cleaned, unless sold as washable. Put the gloves on the hands and wash in warm, soapy water as though washing the hands. Rinse thoroughly and hang up to dry. While they are drying, use glove stretchers to bring them into shape, or try them on the hands.

Woollen articles should be washed separately each garment being washed, rinsed and put to dry before the next is begun. The washing is done in warm, soft, well-lathered water by very gentle kneading or squeezing by hand. Very soiled parts should have extra soap solution patted through them. Rinsing is done twice in clear, warm water. Between rinses, the article should be squeezed by hand or put through a MANGLE. Wool should never be twisted or wrung by hand. After being washed, the article should be pulled into shape

and dried in the shade in warm, dry, moving air. Woollen garments are best dried by spreading out flat on a clean non-fluffy cloth, after being worked into the correct shape. If they are hanging up, woollen articles should be shaken occasionally and pulled into shape. Woven articles may be ironed or pressed while slightly and evenly damp. See also IRONS.

Handkerchiefs should be steeped before washing in water containing 1 tablespoonful of salt to 1 quart of water, adding a little disinfectant when necessary. Remove them from the steeping water and wring, then wash by rubbing thoroughly. Rinse in warm water, then in cold, and boil for twenty minutes. Next rinse, then rinse in blue water, and hang out to dry. Iron while damp, and air. See IRONS.

Woollen stockings are washed like other woollen articles. For washing cotton stockings (hisle stockings are made of cotton), the water should be warm, not hot, wash one article at a time by kneading and squeezing by hand. Rinse first in warm water, then twice in cold. Both cotton and woollen stockings can be passed through the MANGLE. When hung to dry they should be hung from the heel or the toe. When washing silk or rayon (artificial silk) stockings, the water for both washing and rinsing should be just warm enough for washing by hand. Keep the material under the water to avoid stretching it, and wash quickly. After rinsing, the moisture should be squeezed (not wrung) out by hand. the stockings should then be placed on a towel and carefully worked into shape before being dried. If they are hung to dry they should be hung by the heel or toe. They should never be pressed or ironed. To lengthen the life of

silk and rayon stockings, wash them after each time of wearing

LAVOISIER, Antoine (1743-1794), was a French chemist famous for his investigations on burning and the composition of the air. Owing to his connexion with pre-revolutionary tax collectors he was unable to escape the guillotine during the French Revolution

LAW COURT Two kinds of cases come before English courts (1) *Civil* cases, in which there is a dispute between two citizens over such things as money, land, property, will, accident, divorce, etc. The person who brings the case before the court is called the plaintiff and the other person is the defendant (2) *Criminal* cases, in which a breach of the law is alleged

Minor civil cases are tried locally in a Registrar's Court or a County Court, serious cases in the High Court of Justice in London. This Court is divided into Probate, Admiralty and Divorce, King's Bench, and Chancery divisions

Offences against the law are not all considered to be of the same gravity. There are petty offences, such as riding a bicycle without a light, petty theft, drunkenness, and these are usually dealt with in the lower courts. The more serious crimes are of three kinds

- (a) misdemeanours, such as fraud, perjury, poaching, housebreaking,
- (b) felony, such as assault resulting in injury, arson, rioting, manslaughter, murder,
- (c) treason, such as causing disaffection among the armed forces, communicating with the enemy in time of war

These cases are tried in the higher courts. In England the lowest court is the Court of Petty Sessions, presided over by two or more **MAGISTRATES** or **JUSTICES OF THE**

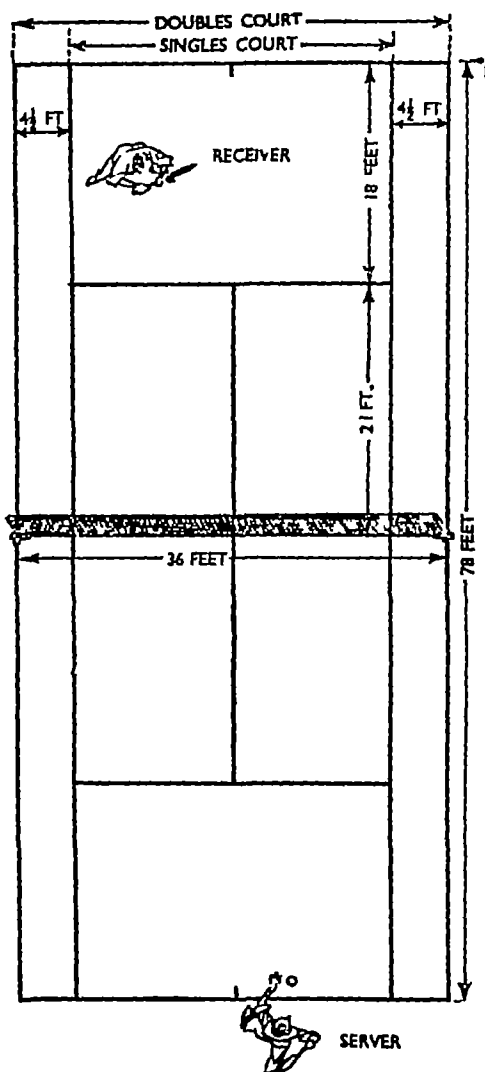
PEACE to deal with petty offences. In London and the larger cities there are courts presided over by a salaried magistrate called a stipendiary magistrate. Graver offences are dealt with at Quarter Sessions or Assizes. Assizes are held at various places throughout the country, presided over by a **JUDGE** or **judges**

There are also Courts of Appeal, the final appeal being to the House of Lords. For child offenders there are separate courts (see **JUVENILE COURTS**)

Scotland has its own law and law courts. There are Police Courts in towns and burghs presided over by one or more of the burgh magistrates, and in the counties Justices of the Peace Courts, in which petty offences are tried. Above these are the Sheriff Courts in the various counties for all civil cases and for the more serious criminal cases. If any crime is punishable by more than two years' imprisonment the case is sent to the High Court of Justiciary, a circuit court presided over by a judge. For more difficult civil cases and for appeals in civil cases there is the Court of Session, and appeal to the House of Lords

LAWN To make a lawn, dig over the site to one spade's depth, level the soil, tread it down and rake over it. In March or April or preferably early September sprinkle with seed and rake over lightly. Grass should appear in from ten days to three weeks. To keep birds from eating the seed, criss-cross the area with black cotton thread to which screws of paper have been attached at intervals or, better still, bits of tin which jangle in the wind. See **DIGGING**

LAWN TENNIS can be played on a grass or hard surface court, which is marked out as in the



Lawn tennis court

The ball, a hollow rubber one covered with felt, $2\frac{1}{8}$ inches in diameter, weighs 2 ounces. The game is played between two players (singles) or two pairs of players (doubles). When singles are being played, the two outer side lines are not used and the inner lines become the boundary. The players decide choice of side or serve by spinning a racquet and calling "rough" or "smooth", this refers to the coloured string near the base of the racquet, one side of which is rough and the other smooth.

The players go to their respective ends, the server, standing on the right of the court and with both feet outside the base line, strikes the ball with his racquet, sending it over the net (3 ft 6 in high at each end, 3 ft at the centre) into the diagonally opposite rectangle next to the net. Should his first ball not go there he serves a second ball, if that fails he loses the point. If the ball during the serve strikes the top of the net yet drops into the proper area, it is called a "let" and the service has to be taken again. A ball served correctly has to be returned if possible by the opposing player to whom it is served, otherwise a point counts to the server, and it goes backwards and forwards across the net until out of play, e.g. struck into the net, or outside the opponent's court, when the player sending it loses the point. If a player fails to return a ball after it bounces once anywhere in his court he also loses the point, e.g. he may let it bounce twice or fail to hit it at all. Once the ball has been properly served and is "in play," a player may return the ball before it bounces in his court, this being called a "volley", once the ball has been served, the server may go anywhere inside the court. The server changes position after each point has been decided, serving first from the right-hand side of the court, then the left-hand, diagonally across the net.

Scoring is as follows: 1st point won counts as 15, 2nd point as 30, 3rd point as 40, to win the 4th point wins the game unless both sides score 3 points each, 40-40, when it is called "deuce". One side must then get two clear points ahead to win that game. The first side to win six games wins the "set," unless the score is 5-5, when one side must get two clear games ahead to win. In

important matches, the winner is the first to win three sets

LAWRENCE, T. E (1888-1935), British soldier, scholar and writer. During the First World War he gained great renown by organizing the successful Arab revolt against Germany's allies, the Turks.

LEAD is a soft, dense, metallic **ELEMENT**. It is extensively used by plumbers, who get their name from the Latin word for lead, *plumbum*. Apart from this, it is used for **ACCUMULATOR** plates, and some of its compounds are used in the manufacture of **PAINT**.

LEAF, the chief breathing and food-making organ of a plant. Leaves are usually arranged to get the maximum light, growing alternately, oppositely or in other manner from the stem. Each leaf may have three parts: the base, leaf stem (or petiole), and broader blade (or lamina). Leaves are simple or

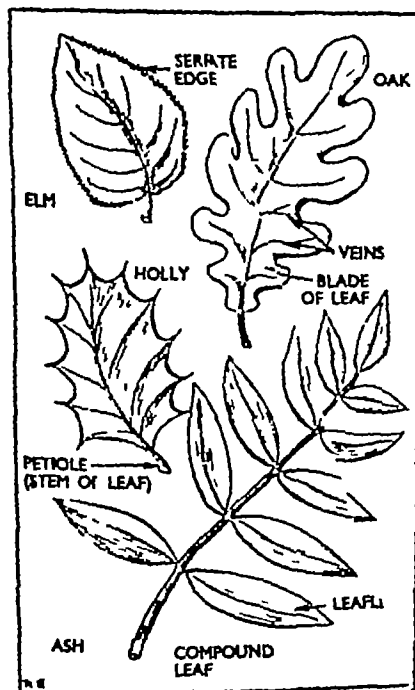
compound (made up of leaflets). The shape, colour, texture, veins and type of edge show much variation. A leaf is made up of layers of **CELLS**, with an upper and lower skin. Pores (the **STOMATA**), arranged chiefly on the lower surface, allow gases to pass in and out. Oxygen, carbon dioxide and water vapour are exchanged in breathing (**RESPIRATION**), during the food-making process (**PHOTOSYNTHESIS**), and in the getting rid of excess water (**TRANSPIRATION**). In autumn the **DECIDUOUS TREE** leaf's activity slows down. A layer of cork forms across its base, gradually constricting its veins so that no more water enters. The leaf changes colour, dries and falls, leaving an already-healed wound, the leaf-scar.

LEAF CROPS are crops grown for the food value of their leaves, such as lettuce, cabbage, broccoli, spinach, etc.

See **ALLOTMENT GARDENING** and **ROTATION OF CROPS**.

LEAGUE OF NATIONS, formed in 1920 after the First World War in the hope of making future wars impossible. About fifty nations joined the League, and each agreed that, when disputes arose between countries, they should be discussed and decided by the League.

The League had its headquarters at Geneva in Switzerland, and a Permanent Court of International Justice was set up at The Hague in Holland. The International Labour Office of the League dealt with labour questions, conditions of workers, wages and health. The League did much useful work, but it failed to prevent a Second World War. The United States was unfortunately never a member of the League, though President Woodrow Wilson was one of its keenest supporters. The League of Nations came to an end in 1946, and



~ ~ Different types of leaf

its place taken by the UNITED NATIONS ORGANIZATION

LEANDER See **HERO**

LEAR, Edward (1812-1888), was the author of *The Book of Nonsense* and *Nonsense Songs, Stories and Botany*. He popularized the limerick, a facetious, five-lined jingle. He was also a painter of talent.

LEAST COMMON MULTIPLE, the smallest number which can be divided by given numbers without leaving any remainder. Thus the LCM of 3, 5, 6 is 30. By separating the numbers into their prime factors, a set of factors can be obtained which will include all the factors of each number involved. Thus to find the LCM of 9, 15, 20

$$9 = 3 \times 3$$

$$15 = 3 \times 5$$

$$20 = 2 \times 2 \times 5$$

so the LCM is

$$3 \times 3 \times 5 \times 2 \times 2 = 180$$

Where there are many small numbers proceed as in the example, where we find the LCM of 8, 9, 15, 16 and 20

2	8, 9, 15, 16, 20
2	9, 15, 8, 10
3	9, 15, 4, 5
	3, 5, 4

Cross out the 8 as it is a factor of 16, divide by 2, since there are at least two numbers which can be so divided, and bring down the other numbers intact. Again divide by 2, bringing down the intact numbers not divided, cross out the 5 as it is a factor of 15. Now divide by 3 since there are at least two numbers which can be so divided. We are now left with three figures, which have no prime factor common to at least two of them, hence further factorizing is unnecessary.

The LCM is therefore the factors remaining multiplied by the

factors used as divisors, e.g.

$$3 \times 5 \times 4 \times 2 \times 2 \times 3 = 720$$

LEATHER is made from the skins of animals, so treated that the fat and softer materials have all been removed. The remaining fibres are tanned or hardened by treatment with vegetable bark extracts or chromium salts, so that they become insoluble in water and are not rotted by it.

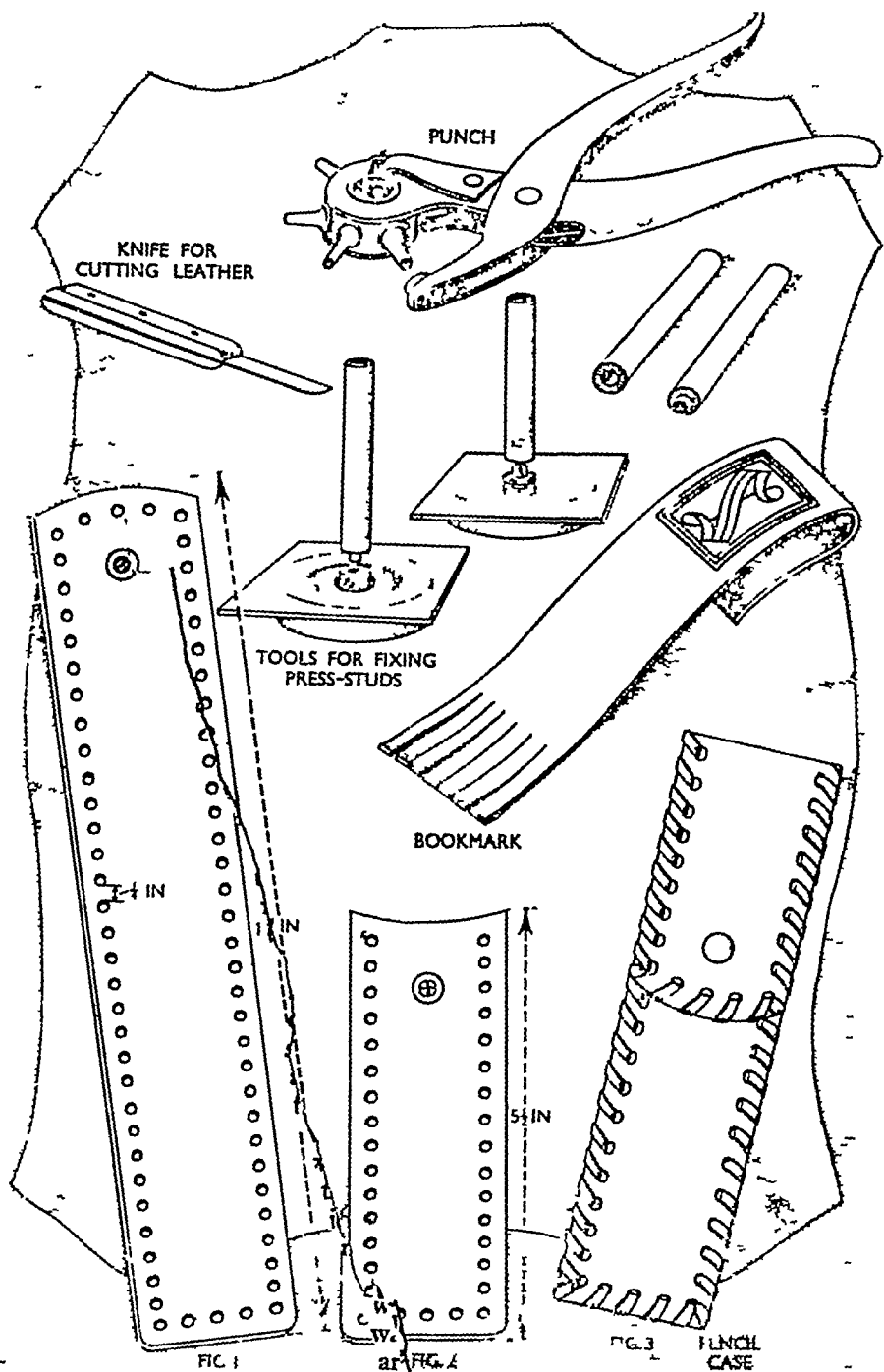
LEATHERWORK is the craft of making useful leather articles.

Different kinds of leather are used according to what is to be made. The most common are suede, calf, chamois, doeskin, and skiver—the last being used mainly for lining.

The tools required include a punch, for making holes in the leather so that thonging can be done. There are two kinds of punches: one that is driven through the leather by striking it with a hammer and the other which has two handles like a pair of pliers. The most convenient kind is the six-hole punch, which is easily manipulated and admits of holes of six different sizes being punched. A board with a strong, smooth surface on which to cut leather is also necessary. In addition, a special knife for the cutting of the leather is required.

Care should be taken to use each piece of leather to the best advantage, and scraps should be retained in a box.

Unless the article to be made is a very simple one with straight edges, such as a bookmark, a pattern should first be cut out in paper. The leather should then be put on a board or other smooth and firm surface, the paper pattern placed on the leather and the outline traced in pencil. Afterwards the cutting-out should be done. If there are straight lines along which



Tools for leatherwork and simple designs to start you off

cuts have to be made, a straight edge (a steel rule is best for the purpose) should be placed along a line, the knife brought up to it, then with the knife held firmly and nearly vertical the cut should be made

The distance apart of the holes will depend upon the size and character of the article to be made. Usually holes $\frac{1}{4}$ inch apart and $\frac{1}{8}$ inch in from the edge of the leather are satisfactory

In the actual punching, it is advisable to place a scrap of leather or a piece of cardboard on the bottom jaw of the punch to prevent the leather from coming into contact with the hard metal surface, and to ensure that clean-cut holes are made

The next process is thonging, lacing with a thin strip of leather to form a simple decoration, or as a means of joining two pieces of leather together.

The thong should be narrow enough to go through the holes easily and it should be pointed at the end to assist in the thonging. If possible use a thong sufficiently long to lace the whole work. The thong should be three times the length of the stretch to be thonged. If it is necessary to join two thongs, they should be sewn together before you commence to thong, and care should be taken to arrange for the join to be on the wrong side of the work. Alternatively, instead of stitching the two thongs together, it is quite possible to glue them. To glue thongs, pare down the wrong side of the new piece and the right side of the old, stick the thongs together with glue where they have been pared. Leave a while to stick, then thong as usual.

Thin leather, such as that used for gloves, may be joined by sewing by hand or by machine

The making of a simple article will give an indication of the general principles, and serve as the basis for the making of further leather articles

To make a pencil case, cut out a piece of leather 11 inches by 2 inches, cutting the top so that it is slightly curved outwards (see 1 in diagram on page 349). Next cut out a piece, $5\frac{1}{2}$ inches by 2 inches, and cut the top of this so that it curves slightly inwards (see 2). Punch holes all round the sides of both pieces of leather, in doing this, care must be taken to see that the holes in the two pieces which have to overlap correspond in position. If the leather is fairly thin it may be possible to punch through both pieces of leather at the same time; if this cannot be done, place the second piece of leather under the first and punch through the holes already made in the first piece. Thonging can then be commenced, place the two pieces of leather together—when lacing through both thicknesses of leather put the thong twice through each corner hole. Continue the thonging for decorative purposes where there is only one thickness of leather. When the thonging has been completed, fold the top of the back part of the case down over the top of the pocket which has been formed. Press the leather where the fold comes in order to make a crease (see 3).

To finish, fix a press stud fastening into the leather. First punch a hole in the middle of the pocket where the bottom half of the stud is to be inserted and then punch another hole in the corresponding position in the flap where the top half of the stud will be inserted. Press the raised part of the bottom half of the stud through the hole that has been punched for it and

place its cap over it. Do similarly with the top half of the stud, place the two halves in position, and after putting an odd piece of leather under and over the press stud give one or two sharp hits on the top of the stud with a hammer. This will secure the stud firmly in position and make it so that it will open and close correctly. Better still, use the simple tools for fixing press studs shown in the diagram.

To make a comb case, cut out two pieces of leather, one 7 inches by 2 inches, and the other $4\frac{1}{2}$ inches by 2 inches and proceed as in making the pencil case.

LEBANON See SYRIA AND LEBANON

LEECH See WORM

LEITMOTIV, a tune associated with a character or situation in an OPERA, and played by the orchestra whenever that character or situation comes into the story.

It is much used in WAGNER's operas.

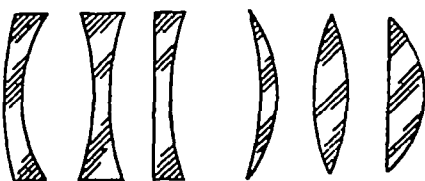
LEMUR See MONKEY

LENIN was the pen-name of Vladimir Ilyich Ulyanov. He was born in 1870 at Simbirsk (now called Leninsk), south of Kazan. His father was a school inspector. An elder brother, Alexander, was implicated in a plot to kill the Tsar (1887) and was sent to the gallows, and this made a great impression on Lenin, then seventeen years of age. Lenin was expelled from Kazan University for student political activities, but was later allowed to return there, where he studied law and the writings of Karl Marx. Later he studied law in St. Petersburg (now Leningrad) and organized trade unions, though illegal in Russia. For this he was imprisoned, and in 1897 he was banished to Siberia. Three years later he went to live at Munich, and later moved to Switzerland, where

he became one of the leaders of the Russian Social Democratic Revolutionary Party. The second congress of this party (held in London in 1907) split over questions of programme. Lenin supported the majority, the *Bolsheviks*, their opponents being the minority, or *Mensheviks*. The Bolsheviks became the Communist Party.

After three years of the FIRST WORLD WAR, Russian Tsardom collapsed. A temporary government of Liberals failed to cope with events. The people wanted the war to end, and Lenin and his revolutionary party were the only group able to gain the support of the masses. He returned to Russia in time to guide to success the Bolshevik Revolution, made peace with Germany, and commenced the work of rebuilding and extending the country's industries, while facing the menace of civil war and famine. Worn out with the work of laying the foundations of a new state and ill from the effect of a bullet wound fired by a political opponent, he died in 1924, and was succeeded by STALIN as secretary of the Communist Party. Lenin and Stalin are now recognized as two of the greatest though sternest rulers Russia has ever known in her thousand years' history. See UNION OF SOVIET SOCIALIST REPUBLICS.

LENS, a piece of transparent substance, usually glass, so shaped that it bends parallel rays of light passing through it into a cone of rays. With a convex lens the rays are bent towards a single point.



Concave lenses and convex lenses

called the focus, and if a lens is held so as to focus the sun's rays on to a piece of paper the paper will catch fire. Lenses are widely used in TELESCOPES, CAMERAS, MAGIC LANTERNS, CINEMATOGRAPHIC PROJECTORS, MICROSCOPES and spectacles.

LEONARDO DA VINCI (1452-1519), was born in the small Italian village of Vinci near Florence in 1452, and during the wonderful period of the Italian RENAISSANCE. He became one of the greatest painters that ever lived, but in addition he distinguished himself as sculptor, architect, civil and military engineer, and as scientific inventor.

From his earliest years he showed so much practical skill that he was placed under the tuition of one of the most famous craftsmen of his time, Andrea del Verrocchio.

At the age of thirty he had entered the service of the Duke of Milan as an artist and engineer, a

post which he held until 1499, when Louis XII of France drove the Duke out of Milan and Leonardo went to Florence. It was during his period in Milan that his equestrian statue of Francesco Sforza was erected in the Castello of Milan and between 1494 and 1498 he painted the famous masterpiece, "The Last Supper" of which, although it no longer remains, there are engravings and copies which give a good idea of its excellence.

Whilst at Florence he painted the celebrated portrait of Mona Lisa del Giocondo, sometimes known as "La Gioconda."

In 1502 he was appointed chief engineer of the papal army; the next year, after visiting many of the fortified places in the papal dominions, where his engineering skill was put to good use, he returned to Florence.

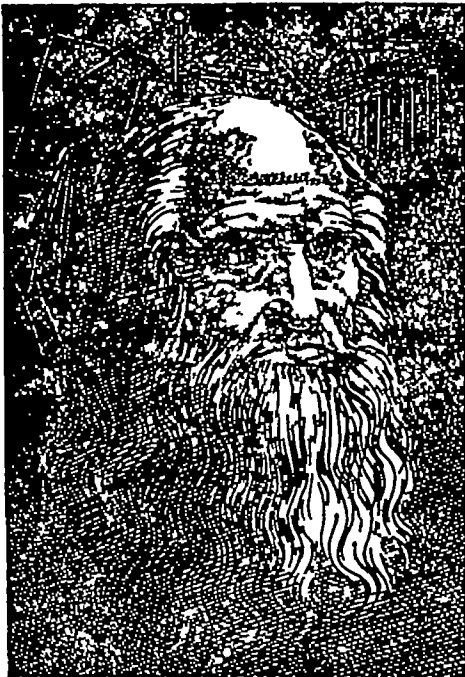
In 1506 he was in Milan, and visited Rome in 1514 where he worked for Pope Leo X. After two years in this city he went to Pavia, entered the service of Francis I and accompanied him to France. He died in 1519 at Cloux while engaged in supervising the construction of a canal.

In addition to the "Mona Lisa" and "Last Supper" the following are among his most famous paintings: "The Annunciation," "Adoration of the Magi," "St Jerome," "The Virgin of the Rocks," "Madonna and Child with St Anne."

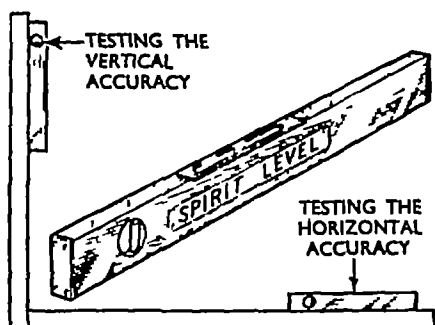
LINTPARD See CAT

LETHE, in CLASSICAL MYTHOLOGY, is a river of the lower world, the drinking of the water brought forgetfulness.

LEVANT is a name applied to the eastern Mediterranean, particularly the coasts of Asia Minor, Syria, Palestine and Egypt. See map of the NEAR EAST.



Leonardo, many-sided genius



Builders' spirit level

LEVEL, SPIRIT, instrument used by builders to tell them when a surface is truly horizontal or vertical. The diagram shows a level, consisting of a rectangle of wood, the edges of which are dead straight and often protected by brass strips. In the middle of one long side and across one end are inserted bubble tubes. These are curved glass tubes almost full of alcohol, leaving an air bubble; alcohol is very mobile and does not freeze in cold weather. Across each glass tube are two scratches, and the tubes are so fixed in the wood that when the level is held horizontally the bubble in the tube on the long side lies between the two scratches, and when the level is held vertically the bubble is between the scratches on the end tube.

LEVERS See **STATICS**

LEYDEN JAR, a type of electrical **CONDENSER**, a simple example of which is a glass jam jar with the inner and outer surfaces of the lower half and bottom covered with tin foil. The central brass rod passes through a wooden disk and makes contact with the bottom of the jar by means of a chain. The outside is connected to earth. It is supposed to have been discovered at Leyden in Holland when an experimenter, who held a charged jar of water in his hand, touched a piece of metal in the water and received a shock.

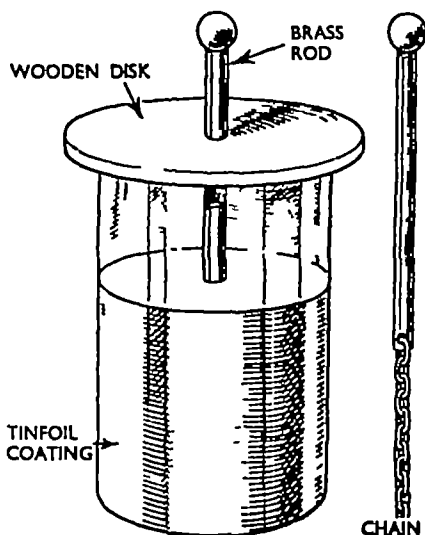
LIBERALISM See **TORIES** AND **WHIGS**

LIBERIA is a West African republic, founded in 1847 for freed negro slaves who wished to leave the United States, and controlled financially by the United States. The chief exports are rubber, palm oil products and gold. The capital is Monrovia. See map of **AFRICA**.

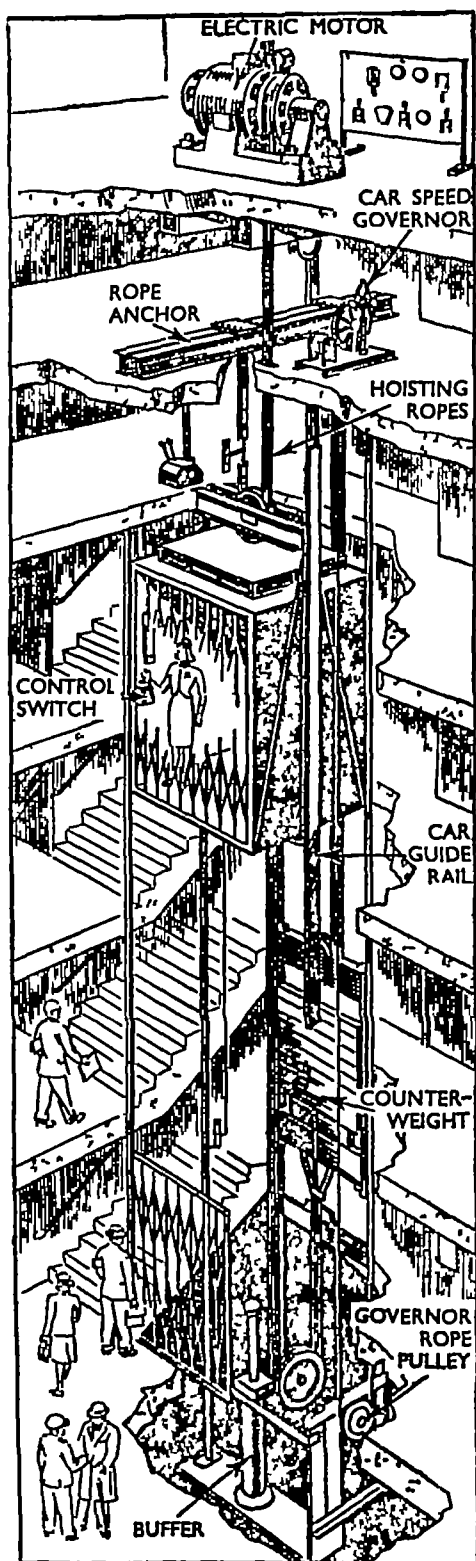
LIBRETTO, the words of an **OPERA**, **ORATORIO** or **CANTATA**.

LIBYA is a former large Italian North African colony, mainly desert and peopled by **NOMADS**, with a few towns on the coast linked by a coast road. The chief towns are the ports of Tripoli and Benghazi. See map of **AFRICA**.

LICENCE, the official permission to do, or sell, something for which the law says a permit is necessary. In Britain a licence is necessary to keep a dog, own and use a gun, own a motor vehicle, drive a motor vehicle, use a wireless set, act as an auctioneer, carry on business as a pawnbroker, hawk goods, sell tobacco, cigars and cigarettes, sell patent medicines, and sell beer, ale,



Simple type of Leyden jar



How the passenger lift takes people from one floor to another

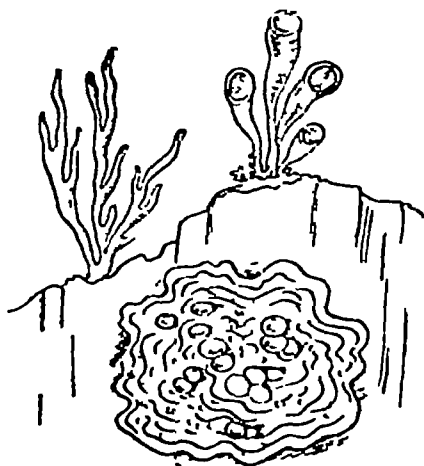
wines and spirits Hotels and restaurants in which intoxicating liquors are sold and consumed are spoken of as "licensed premises"

LICHEN, a group of small plants which grow on trees and dead wood and encrust rocks and walls Each lichen consists of a **FUNGUS** and an **ALGA** plant living together They may be grey, grey-green, yellow, black or orange, and form fruiting bodies like little cups or horns

LIFT. When we wish to go to the upper floors of a high building, we cannot afford the time and energy to climb the stairs by foot So we use a lift, a cage or car held by a cable which passes over a drum at the top of the building The other end of the cable is attached to a weight which balances the weight of the car and its passengers The drum is turned by an electric motor or by water pressure, and this power is controlled by press buttons in the car. The door of the lift and the doors of the shaft in which the lift travels are controlled by safety devices to prevent them opening when the lift is not standing at a floor.

LIGHT is a form of radiant energy which affects our eyes Its source is usually a very hot substance, though under certain conditions cold bodies such as luminous fish and fungi can give out light The path of the energy, called a ray, is a straight line until it is reflected by a shiny surface, or refracted by passing into a substance in which it moves with a different speed See **LENS**

Scientists are still not quite certain as to what light really is Some light can be seen by the human eye, while other light cannot We know that the velocity of light is 186,325 miles per second, a truly enormous speed (see also **LIGHT YEAR**), and that **COLOUR**



Alga and fungus form a lichen

consists of light of different wavelengths Daylight contains all the colours (see RAINBOW) an object will absorb light of certain colours and reflect light of others, and it is this reflected light which strikes the EYE and provides the colour we associate in our mind with that object Since artificial light (see LAMP) is different from daylight, colours look different in it

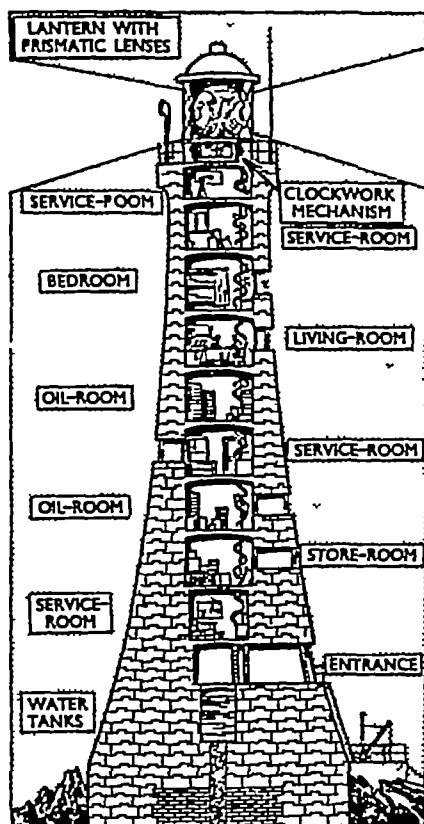
The light coming from any source can be split up by a SPECTROSCOPE and examined for its characteristics It is under the influence of the light of the sun that the CHLOROPHYLL in plants is able to extract carbon dioxide from the air with which to feed the plant lack of this light, too, is responsible for impoverishment of the skin and body, and light of certain wavelengths is used in hospitals to cure particular complaints Light, therefore, does more than enable us to see—it enables us to live

LIGHTHOUSE In order to navigate safely, especially without the help of wireless, sailors need fixed known points on the map to find their position or to avoid dangerous spots At night or in dull weather, these fixed points are sup-

plied by bright lights carried in lighthouses, or in lightships where it is too difficult to build a lighthouse The light comes from powerful gas or electric lamps, and is concentrated into a beam by huge lenses or reflectors To distinguish one beam from another, the light is not continuous, but comes in flashes of varying duration at varying intervals, the flashing being controlled by a clockwork mechanism Thus no two lights can be confused

To withstand the wind lighthouses are built of interlocking blocks of masonry

In many places buoys with lights on them are used instead of lighthouses and light-ships



Inside a lighthouse

LIGHTNING. Clouds become charged with electricity owing to evaporation and other causes. When this electricity leaps to earth or another cloud the huge spark so caused is called forked lightning. Should this spark pass through a tree, building or person, it will destroy it. If, however, a conductor such as a copper strip is led from a point on the highest place on the



Lightning conductor on church

building down to the ground, the electricity passes safely down the strip and does not cause any damage. Sheet lightning is the reflection in the sky of distant unseen forked lightning.

LIGHT YEAR. The distances which astronomers measure are so immense that ordinary measures are too small. Consequently they use a unit called the light year, which is the distance that a ray of

light can travel in a year. As light travels 186,325 miles in one second a light year is equal to this number of miles multiplied by as many seconds as there are in a year. A light year is about 6 million million miles. The Pole Star, for example, is forty-seven light years distant from the earth.

LIME is a white powder formed by strongly heating limestone or chalk. The material so produced is called quicklime. It is a corrosive **ALKALI**, when wetted it absorbs the water and gets very hot and becomes slaked lime. Mixed with sand, it forms builders' lime mortar, it is also used as a fertilizer for fields and gardens. Its solution in water, lime water, turns milky when **CARBON DIOXIDE** is added—what has happened is that the lime has been turned back into chalk which appears in the water as a white insoluble substance.

LIMESTONE is a hard rock similar in origin to **CHALK** and often containing large shells. It is used for building.

LIMEWATER is a solution of slaked **LIME**, used in chemical experiments and for medicinal purposes when too much acid is present in the stomach.

LIMING is the spreading of lime on the **SOIL**, which starts a chemical process which makes the plant foods already in the soil more easily available to the plants. Lime is not a manure and must never be mixed with manure, for the effect, through chemical reaction, would be to cause valuable plant foods to be lost. Two months should elapse between the application of each to the land. Hydrated lime is the most convenient type for garden use. See **MANURING**.

LINCOLN, Abraham (1809-1865), sixteenth President of the United States of America, was born

in a small log cabin in Kentucky in 1809

His parents were poor and when Abraham was seven years of age they moved to another district, and here he helped his father to build a cabin of roughly hewn logs and to make some simple furniture for the home

Naturally there was no school in such a region His father could not spell his own name, but his mother had some education and did her best to teach Abraham to read and write She urged the boy to "learn all he could and be of some account in the world" Writing materials were scarce and so during the winter nights he would figure out his sums with a piece of charcoal on the back of a shovel

When he was twenty-one he set out to make his way in the world, and during the next few years he turned his hand to a number of occupations he became captain of a volunteer company, he was a clerk, he opened a country store, and was appointed a village post-master.

Educating himself, he studied law, with the result that before he was thirty he had qualified as a lawyer

In 1846 he was elected to Congress for the central district of Illinois and allied himself with the anti-slavery party Nine years later, and again in 1858, he unsuccessfully attempted to get himself elected to the Senate, but in May, 1860, when the Republican National Convention met at Chicago he was nominated as a candidate for the presidency, and eventually in November, 1860, he was elected, and took office in March, 1861 The Southern States, however, owing to the anti-slavery policy of Lincoln and many of the leading Republicans, refused to



Abraham Lincoln, President

confirm his election and one by one they broke away from the Union of States

Lincoln was greatly grieved about this, for although he wanted to abolish SLAVERY, at the same time he was anxious to save the Union and did not want the Northern and Southern States to be divided into two countries But a terrible civil war broke out between the Northern and the Southern States which lasted for four years So skilfully did he pilot the country through this exacting and troubled period that in the end the Union was saved and slavery abolished

Unfortunately, however, just before the end of the war, the joy of the nation was suddenly turned to sorrow, for President Lincoln was shot by an assassin and died the following day, 15th April, 1865

LINO CUT. See WOODCUT

LION See CAT

LIQUID AIR AIR like any other GAS turns when cooled and compressed to a liquid The temperature needed is very low and the pressure must be extremely high If the liquid air is allowed to boil

slowly, the nitrogen in it comes off first, leaving behind liquid OXYGEN

LIQUID FIRE is a name loosely used for any liquids which burn easily in air, such as those used in flame-throwers

LISTER, Joseph (1827-1912)
This great English surgeon and the first to make use of **ANTISEPTICS** in his work of healing was born on 5th April, 1827, at Upton in Essex, and was a son of a scientist

At the age of twenty-eight he became a house-surgeon at the Royal Infirmary, Edinburgh, and here he began to lecture on surgery

Before the use of antiseptics was known, hospitals were places where diseases due to the festering of wounds were difficult to prevent and such terrible scourges as gangrene caused many to die

He spent years in most careful research and knowing that these deadly festering wounds were due to certain microbes, he strove for greater cleanliness in the care of patients—more linen and towels and washing equipment

Lister's next problem was how to destroy these harmful microbes. He tried experiments with carbolic acid, which cured yet proved too painful for general application. Gradually, however, by blending his materials, he discovered an antiseptic which would prevent blood-poisoning without at the same time too violently irritating the skin of the patient

In 1869 Lister had become head of the department of clinical surgery in Edinburgh University, and during the next few years he did much to improve upon his early discoveries. He invented absorbent dressings of sterilized gauze, he made researches in bacteriology and invented a spray of carbolic solution designed to keep the air free from microbes. But he soon

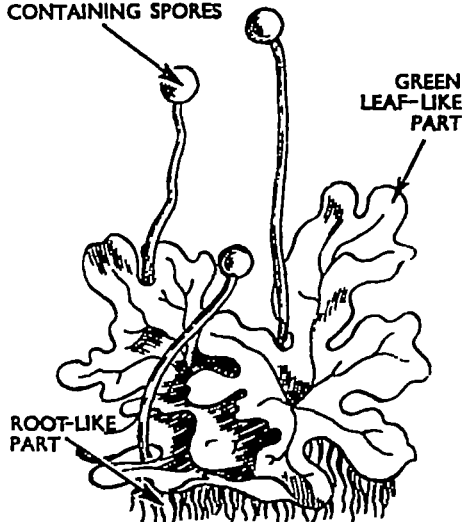


Lister, first to use antiseptics

saw that during operations not only the atmosphere but the doctors and nurses must be carefully freed from the presence of microbes, and thus he laid the foundations of the meticulous cleanliness which is such a feature of modern surgery

He died in 1912 after a lifetime of noble service to humanity, and the Lister Institute of Preventive Medicine in London is a monument to his work and genius

CAPSULE
CONTAINING SPORES



Liverwort, related to moss

LISZT, Franz (1811-1886), was a great Hungarian pianist, prolific composer and encourager of young and unknown composers

LITHUANIA is a small Baltic state which was incorporated in 1940 into the Union of Soviet Socialist Republics Its capital is Vilna In the interior is much forest and marshland The country produces cereals, flax, and cattle See map of SCANDINAVIA

LITMUS is a plant juice which is naturally purple but which turns red with ACIDS and blue with ALKALIS Litmus paper is blotting paper soaked in the juice and dried, and much used in testing liquids in chemical ANALYSIS

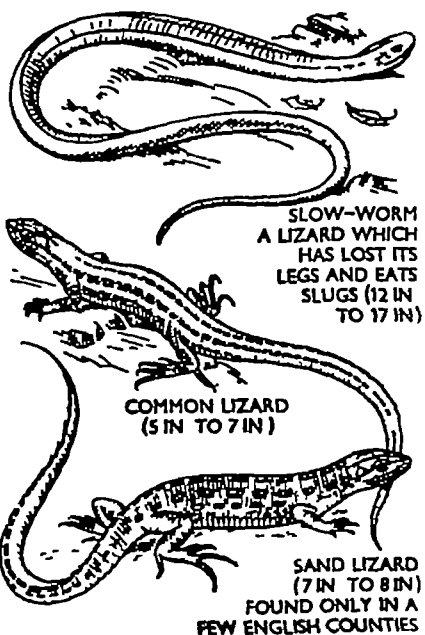
LIVERWORT is the name of a group of small plants closely related to MOSS Many liverworts form thin green coatings over rocks in damp places, the flat, overlapping growth supposedly like liver lobes Some have upright stems bearing leaves Like mosses they form spores They were once esteemed as a remedy for liver complaints

LIVERY COMPANIES are associations in the City of London which originated in the craft GUILDS of the Middle Ages The members of these companies elect the Lord Mayor of London and his sheriffs They include the Mercers', Drapers', Fishmongers', Goldsmiths' Company, etc Today the companies are mainly charitable trusts

LIVINGSTONE, David (1813-1873), Scottish missionary and explorer, was born near Glasgow, worked in a cotton mill, became a doctor and in 1840 went to Africa, where he spent most of his life in exploration, at the same time he preached the Christian faith He died in Central Africa in 1873 and his body was brought to England and buried in Westminster Abbey See also EXPLORATION

LIVY (Titus Livius, 59 B C - A D 17), wrote the *History of Rome* in 142 books, of which only thirty-five have come down to us complete

LIZARD, a REPTILE group, varying in size from a few inches to the 6 feet of the komodo dragon of the East Indies Most lizards have four legs with clawed toes, others like the British slow-worm (or blind-worm) are legless The long tail can be shed in an emergency The common lizard is about



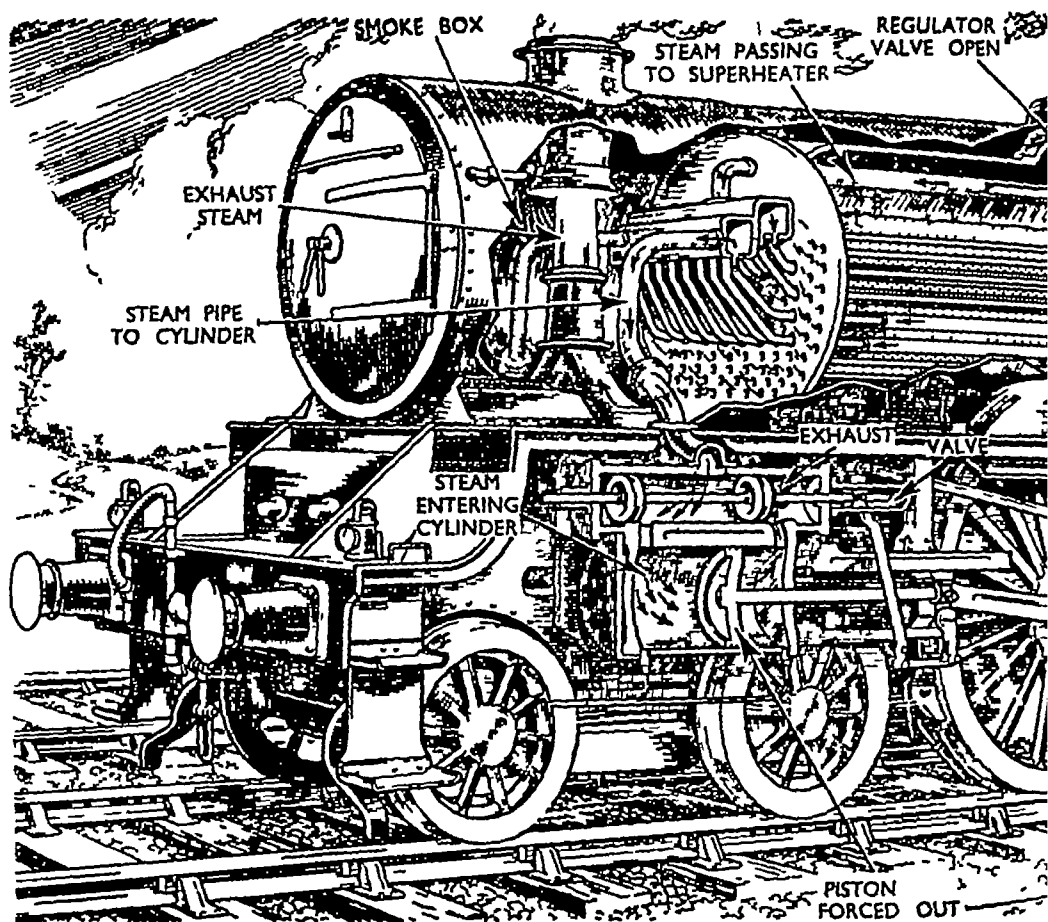
Lizards found in Britain

5 inches long, frequents grass and moorland, and moves very swiftly Most lizards HIBERNATE Other lizards commonly seen in zoological gardens are skinks, the green lizard, geckos with adhesive toes, basilisks, iguanas and CHAMELEONS

LLAMA See HOOFED MAMMALS, TRANSPORT

LOBSTER See CRUSTACEANS

LOCAL GOVERNMENT deals with matters concerning the city or



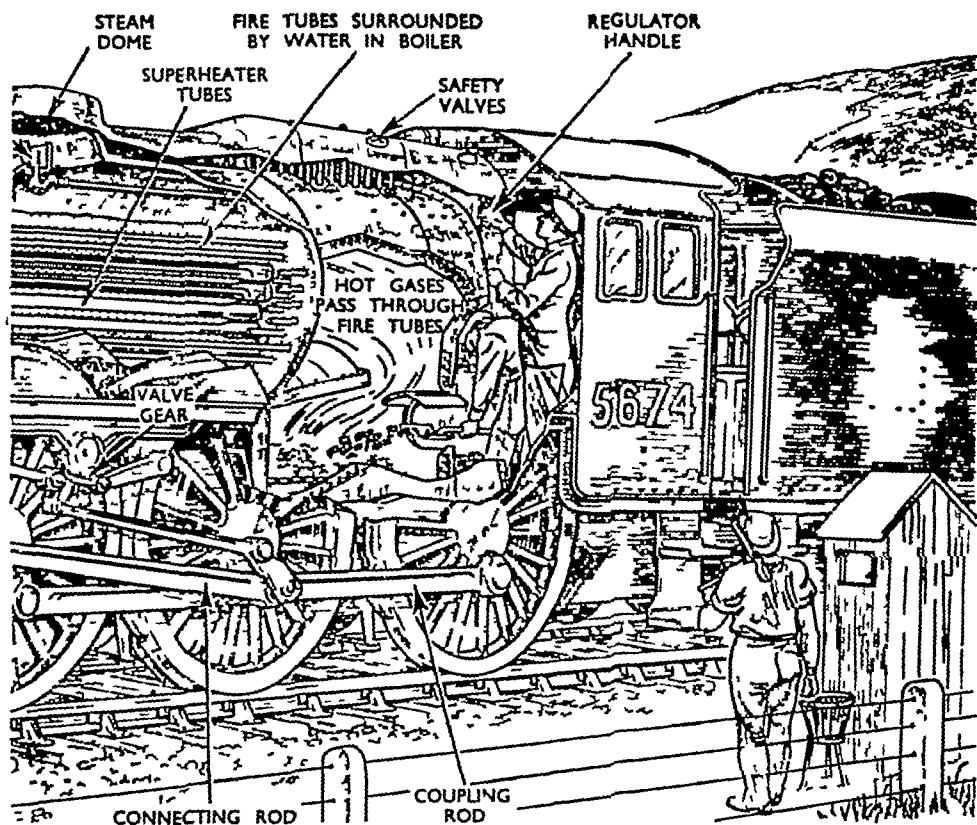
Locomotive in which superheated steam from the boiler

county as distinct from the affairs of the nation dealt with by Parliament. The main local bodies are town or borough councils, county councils, urban and rural district councils. See under **TOWN OR BOROUGH COUNCIL** for the method of election, work, officials, and finances of a typical local government body.

LOCOMOTIVE, an engine driven by steam, oil, or electricity, which uses its power to pull itself and loaded coaches or wagons along a special track.

The illustration shows the relationship of the various parts of a steam locomotive. Coal is burnt in the fire-box, whence the flames and hot gases go through fire tubes in

the boiler to the funnel. The water in the boiler becomes hot, steam collects at the top in the steam dome, and, when the regulator valve is opened by the driver, the steam goes back through the superheater tubes in the boiler to come out hotter than ever. It then passes into each piston cylinder, pushing the piston first in one direction, then (when a valve operates) in the other direction, the steam after use escaping through exhaust holes to blow up through the funnel, thereby increasing the draught of the fire. The backwards and forwards movement of the piston rod is transmitted by a connecting rod to the wheels which are coupled together. By means of



pushes to and fro the piston connected to the wheels

the valve gear it is possible to alter the position of the valve in relation to the wheels, so that the piston rod pushes the wheels round the other way, thus making the locomotive go backwards. The driver and fireman ride in the cab, where are to be found the engine controls, gauges, and train brakes. Coal is carried in the tender behind the locomotive. See **ENGINE** and **RAILWAYS**.

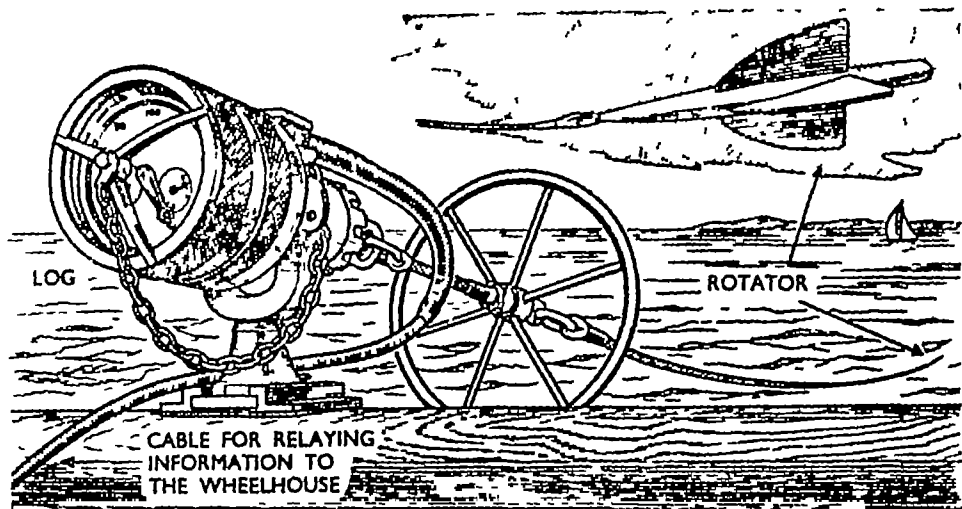
LOCUST. See **COCKROACH**.

LOGARITHMS Common logarithms provide a short method of solving problems with very large numbers. They are simply indices (see **POWERS AND INDICES**) to the base 10. Thus 10 is 10^1 , 100 is 10^2 , 1,000 is 10^3 , and so on. Obviously

any number between 10 and 100 will have a logarithm between 1 and 2, between 100 and 1,000, a logarithm between 2 and 3. The log of a number less than 10 will be a decimal fraction. $\log 2 = 3010$, $\log 584 = 2.7664$.

When we multiply powers of the same number we add the indices, so to multiply two or more numbers we add their logarithms and then see what number the sum of the logarithms represents.

When we divide one power of a number by another power of the same number we subtract the index of the divisor. In the same way we subtract the logarithm of the divisor from the logarithm of the number to be divided, and find



Nautical log recording the distance the ship has travelled

what number the reduced logarithm represents

To find the square root of a number, we halve its logarithm, for the cube root, we take one-third of its logarithm, etc

The whole number part of a log is known as the characteristic, and may be positive or negative, according to whether one is multiplying by powers of 10 or 1. The decimal part of a log, the mantissa, is always positive

Multiplying by a decimal fraction will reduce a number, hence the characteristic of a log of such a fraction is negative, shown by a bar over the characteristic

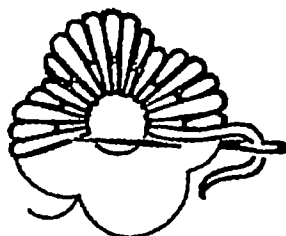
It is by means of tables that we find the logarithms of the numbers we are using, tables of anti-logarithms will convert the final logarithm back into a number for the answer

LOG, NAUTICAL. To find the speed of a ship, a log of wood fastened to a long line was thrown overboard. The log floated still while the ship sailed on. In the line were knots at such intervals that the number of knots passing in a certain time through the hand of the sailor operating the log was

equal to the speed of the ship in nautical miles per hour, or "knots". Nowadays an automatic log is used, it is fastened to the stern of the vessel, and tows a small rotator through the water; this rotator works the dial of the log, thereby recording the distance the ship has travelled

LOLLARDS, the nickname given to the "poor preachers," the followers of John WYCLIFFE, one of the earliest of religious reformers and famous in the reign of Edward III and Richard II. There were Lollards in England during the 14th and 15th centuries, when they were cruelly persecuted. Although Lollardism was suppressed, it did not die out, but remained to give strength to the REFORMATION of the 16th century

LONG AND SHORT STITCH



Long and short stitch

is similar in appearance to SATIN STITCH, but in the first row the stitches are worked alternately long and

short. Subsequent row fill in the gaps, but after the first row the stitches are all of one length. It is generally used for filling leaves or flower, but it can be used successfully for outlining.

LONGITUDINAL See **WAVE**

LOOP STITCH See **BLANKET STITCH**

LORD HIGH CHANCELLOR, the leading dignitary of the law in England and the man who presides over the House of Lords. See **JUDGE** and **PARLIAMENT**.

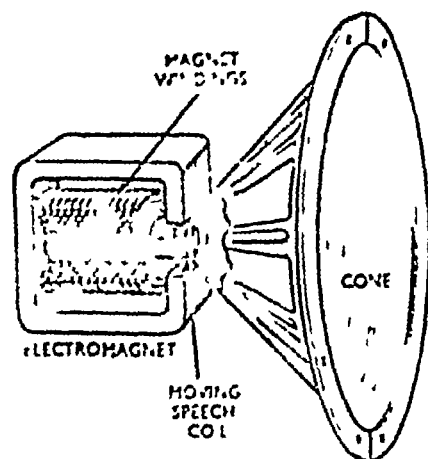
LORD LIEUTENANT, an official appointed by the Crown to be the permanent representative of the sovereign in a county. He is the head of the magistracy, the means of communication between the Government and the magistracy, and recommends to the Lord High Chancellor persons for appointment to judicial or other places.

LOUDSPEAKER, that part of a receiving set where a varying electric current is turned into sound waves. The first type of loudspeaker was just a large TELEPHONE ear-piece, with the diaphragm placed at the end of an amplifying cone. The modern moving coil loud-

speaker has a strong ELECTROMAGNET, and a moving speech coil (turns of wire round a cylinder) fixed to a diaphragm consisting of a stiff paper cone. The electromagnet has one pole extended and bent round to form a gap, in which is situated the moving speech coil. The other pole of the electromagnet is a central rod, wound with wire, which projects into the moving speech coil. The electromagnet, which is magnetized according to the degree of current in its wire windings, magnetizes the moving speech coil which moves to and fro in the gap in accordance with the variations of the current, and thus produces sounds from the cone.

LOUIS XIV (reigned 1643-1715) was one of the greatest monarchs of modern times. He became King of France at the age of five. Louis was a man who noticed and remembered everything. He probably knew more about the affairs of Europe in his time than any politician. He was called "the Grand Monarch" and "the Sun King" (*le Roi Soleil*), and he professed to hold his power from God—he is supposed to have said, "*L'état c'est moi*" ("I am the State").

Louis XIV's reign falls into three periods: (1) his minority, when the country was ruled by Cardinal Mazarin, (2) the period of Louis's greatness and absolute monarchy (1661-1681), a time of almost incessant warfare with the Spanish, Dutch and English, (3) a period of decline (1681-1715). He revoked the Edict of Nantes which drove the HUGUENOTS, some of the best French craftsmen, to take refuge in other countries. The war with the Grand Alliance, in which nearly the whole of Europe was lined up against the French, ended with



Moving coil loudspeaker

the Peace of Ryswick, 1697 Three years later came the War of the Spanish Succession, famous for the victories of the English Duke of MARLBOROUGH, and ending with the Peace of Utrecht in 1713

Louis XIV not only spent vast sums on wars, but he built a magnificent palace at vast expense at Versailles which was the admiration of Europe He died in 1715, and was succeeded by his great-grandson, Louis XV

LOYOLA, St Ignatius of (1491-1556), was converted while recovering from a severe wound as a soldier He took the dress of a beggar, went on a pilgrimage to the Holy Land, and, after visiting his native country of Spain, started the Society of Jesus (the Jesuits) in Paris with the aid of Francis XAVIER The society quickly became a powerful religious order

LUBRICANT, usually a liquid or grease, which is fed in between two rubbing surfaces to reduce the friction The commonest liquids used are petroleum oils and fatty oils such as castor, rape, and lard The more solid greases are made from oil and soap or tallow Graphite, a solid which gives fine greasy flakes, is used when the pressures are high.

LUKE, St, was a doctor at Antioch and a Christian He joined St PAUL at Tarsus on the second missionary journey (about A D 50) and went with him to Philippi On the third missionary journey, St Paul met him again at Philippi, and they remained together for the rest of St Paul's life St Luke wrote his GOSPEL and Acts about A D 70 Tradition says that he was a painter, and he is the patron saint both of artists and of physicians

LUTE, an ancient member of the class of instruments of which the strings are plucked by the finger

It was a favourite instrument at the time of Queen Elizabeth and is still used in Spain See also BANJO, GUITAR, and MANDOLINE

LUTHER, Martin (1483-1546), a German, was perhaps the greatest leader of the REFORMATION As a monk he condemned the sale of indulgences, pardons for punishment due to sin When the Pope



Luther, Reformation leader

sent him a message condemning him, he burnt it at Wittenburg openly, and left the Roman Catholic Church He wrote many books and hymns, and translated the Bible into German

LUXEMBURG is an independent grand duchy to the south of Belgium There are rich iron ore deposits in the south-west See map of BELGIUM

LYNCH LAW is the name given to the irregular method of punishing an offender without a trial in a court of law It may get its name from a Virginian planter, Charles Lynch, who is said to have taken the trial and execution of offenders into his own hands

LYNX. See CAT



MACAULAY, Thomas Babington (1800-1859), English essayist, historian and politician. Educated at Cambridge University, he entered Parliament in 1830, and was later a member of the supreme council for India. As a writer he is best remembered for his *Essays* and his monumental *History of England*, which deals with the period from James II to William III.

MACAW. See **PARROT**

MACHIAVELLI, Niccolo (1469-1527), was born in the Italian city of Florence. He held various political posts, and made several journeys on state business. He was famous as a writer during the Italian RENAISSANCE. His chief work was *The Prince*, which dealt with the founding and maintenance of the State, and in which he gave unscrupulous advice to the powerful on how to maintain their position.

MACHINE. Although the word "machine" is used loosely to denote anything mechanical which "goes," it is really accurately applied only to a mechanism to which we apply a force and which itself overcomes a resistance in a more convenient way. There are many such machines in everyday use—levers, gear wheels, pulleys, wedges, worm gears or screws, windlasses and so on. In some cases a large force moving slowly is changed to a small force moving rapidly, or vice versa, in other cases the power applied is changed from one direction to another. See the picture on page 366.

MADAGASCAR is a large French-owned island off the east coast of AFRICA. The capital, Antananarivo, lies on the inner highlands where cattle and sheep

are reared and maize and millet grown. Much of the island is forest, but rice and sugar are grown on the wet eastern lowlands, and some mica and graphite are mined. Coffee, vanilla, cloves and hides are also exported. Most of the farmers are native Malagasy, related to the Polynesians and Melanesians of the Pacific islands. There are also Negroes and Arabs, but few Europeans.

See map of AFRICA.

MADRIGAL, a song to be sung by several voices, each voice usually entering in turn. Sometimes they were sung to a LUTE or VIOL accompaniment. Madrigals were very popular in English homes in the reign of Elizabeth, whose praises are sung in a famous collection of madrigals, *The Triumphs of Oriana*. The madrigals were often published as "apt for voices or viols," and when played on instruments alone are an early example of CHAMBER MUSIC.

MAGELLAN, STRAIT OF. A channel between the island of Tierra del Fuego and the mainland of South America, connecting the Atlantic and Pacific Oceans. See map of SOUTH AMERICA.

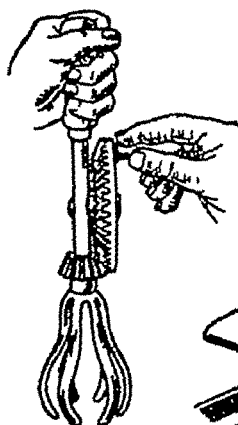
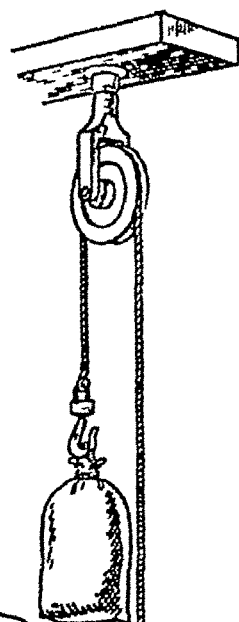
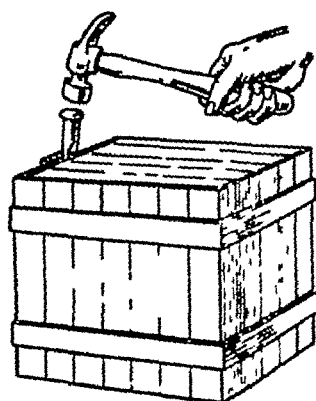
MAGIC LANTERN. See LANTERN (MAGIC).

MAGISTRATE, one entrusted with the important duty of keeping the peace and hearing charges in connexion with offences against it. County magistrates must live in the county or within seven miles of it when they are appointed. Borough magistrates must live either in the borough or within seven miles of it or must occupy a house, a warehouse or other property in the borough. Magistrates are of two

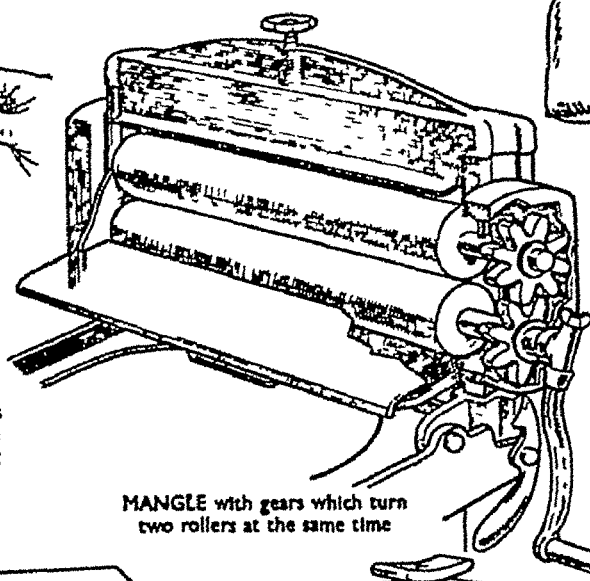


SPADE acting as lever
to force the earth up

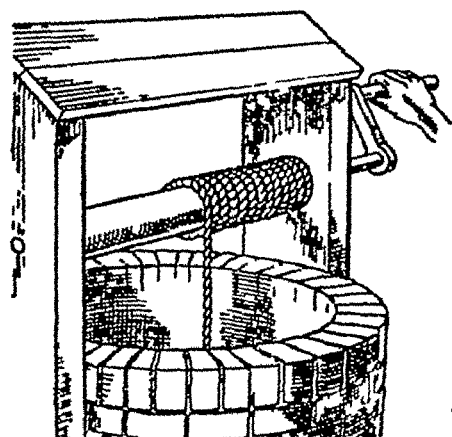
WEDGE for forcing things apart



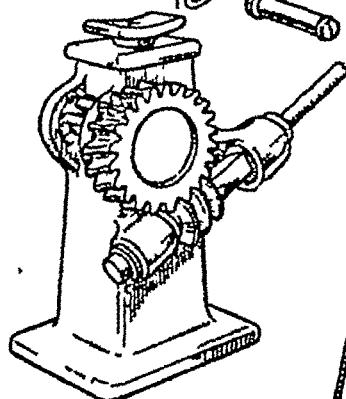
WHISK with gears
to change direction
and speed of turning
done by hand



MANGLE with gears which turn
two rollers at the same time



WINDLASS which changes
circular motion of the hand into
up and down movement of weight



JACK with gears for converting
quick turning of a shaft into
slow upward push



PULLEY which changes
downward pull on rope into
upward movement of weight

Simple machines in everyday use the direction, speed or degree of the force applied is changed so as to do more useful work See page 365

kinds (1) salaried magistrates (stipendiaries) in certain big towns and cities, (2) those whose names have been added to the Commission of the Peace, or who act by reason of their office as mayors or chairmen of county, borough or district councils (see JUSTICE OF THE PEACE)

The duties of magistrates are (1) trying in Court persons accused of wrongdoing, i.e. ascertaining facts and applying the law to them, (2) acting in matters which are subject to Court orders, e.g. the fixing of the hours during which public houses are to remain open, (3) carrying out, in or out of Court, some obligation imposed by law, such as the witnessing of signatures to specific declarations—thus, if a parent has an objection to having his child vaccinated he must sign a special declaration to this effect in the presence of a magistrate

In general one stipendiary magistrate may preside over a Court, but at least two justices of the peace are needed to form a Court, except in the City of London where an alderman is permitted to sit alone

In JUVENILE COURTS three magistrates sit to deal with cases brought before them

MAGNA CARTA. See JOHN

MAGNESIUM is a metallic ELEMENT of low density which burns fiercely in air. Its alloys are used in aircraft construction, and the pure metal is used in incendiary bombs, fireworks, and photographic flash powders

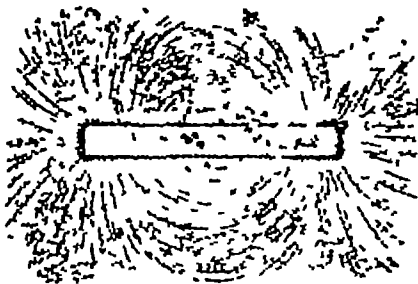
MAGNET and MAGNETISM. The earliest magnets were stones of iron ore found in the soil. It was found that these stones had two peculiar properties: first, certain points on the ore would attract small pieces of iron held near; and second, if these stones were so cut as to have only two of these points,

one at each end of a longish block, and this block were hung up by a hair from its centre, it would set so as to point more or less in a north and south direction. These stones were therefore used by mariners as compasses and called "lodestones," that is leading stones

It was then found that the north-seeking pole of one magnet would repel the similar pole of another magnet while attracting its south-seeking pole. A further discovery was that a piece of steel could be magnetized by stroking it with the pole point of a lodestone

A magnet is also made by winding an insulated wire round a steel or iron bar and then passing a current through the wire (See ELECTROMAGNET). Curiously enough, steel—in such a case remains a magnet after the current is turned off, whereas iron loses its magnetic power almost at once

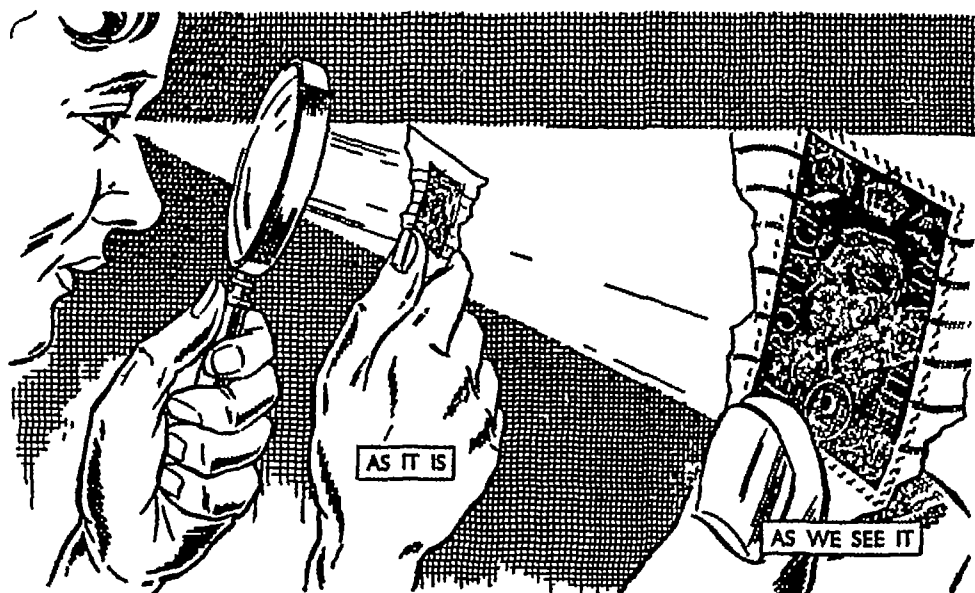
The space round a magnet where its influence is detected is called its field, and this is represented as being filled with "lines of force,"



Lines of force around a magnet

the existence of which is proved by sprinkling iron filings on to a card placed on a magnet and tapping the card gently—a magnetic map is thus formed

A magnet moving near a wire induces a voltage in the latter, and this is the basis of the GENERATOR



The magnifying glass changes the apparent size of an object

MAGNETISM OF THE EARTH. The earth behaves like an immense magnet, with one pole in north Canada and the other in the Antarctic. The positions of these poles alter from year to year, and at the present time they are approaching the geographical POLES.

MAGNETO, a means of producing a high voltage spark for the ignition of explosive gases in petrol or spark ignition ENGINES. It consists of a DYNAMO and an INDUCTION COIL built in together and driven from the main shaft of the engine.

MAGNIFYING GLASS, a convex LENS which when placed before an object causes an enlarged and upright image of that object to appear in it.

MAGPIE, a common large black and white BIRD with a very long tail. It is resident in the British Isles. Its call is a harsh chatter. It nests in trees or bushes, and likes to steal shiny things. See page 76.

MALAPROPISM, the comic misuse of words, so-called from Mrs Malaprop, a character in Sheridan's *The Rivals*, whose talk

was full of misused words "She is as headstrong as an *allegory* on the banks of the Nile."

MALARIA is a fever caused by multiplication of minute PARASITES in the blood. The parasites are injected during the bite of an infected female Anopheles MOSQUITO.

MALAYA is a peninsula of south-east Asia comprising the Malayan Federation, made up of nine Malay States and two British Settlements, and the island of Singapore, which is a separate colony. Rubber and tin are the chief products both of the British and other states, although rice, pineapples, and copra are important. The island of Singapore, separated from the mainland by a mile-wide channel, is the seat of the Governor-General and handles most of Malaya's trade. It is a naval and air base. Penang, the second port of Malaya, is also an island. See map of INDO-CHINA, which it adjoins.

MALTA is a strongly fortified British island in the Mediterranean between Sicily and North Africa, used as a naval base and coaling station. Wheat, barley and toma-

trees are grown, and potatoes, onions and hides are the chief exports, but most of the Maltese, who are of mixed Phoenician and Italian descent, work in the shipyards. The capital of Malta is Valletta. The island was at one time the headquarters of the Knights of St. John (see KNIGHTHOOD). See map of EUROPE.

MAMMAL, the highest class of VERTEBRATES or backboneed animals. Mammals include the primates (man, APES and MONKEYS), FLESH-EATING MAMMALS (the carnivores), INSECT-EATING MAMMALS, HOOFED MAMMALS (ungulates), WHALES, ELEPHANTS, RODENTS, POUCHED MAMMALS, and others. All have warm blood and nearly all a coat of fur, wool, or hair (though this may be very scanty). When the young are born, all mammal mothers feed them on their milk. Picture on page 371.

MANCHURIA (Manchukuo) is a large and valuable territory in north-east China, for some years under Japanese control. The winters are severe, but millet, soya beans and wheat are grown in summer. Coal and iron are mined around Mukden. Part of the trans-Siberian railway system runs through Manchuria. The chief towns are Hsinking, Kirin, Harbin and Mukden in the south, and the port of Dairen. See map of CHINA.

MANDATE and MANDATED TERRITORIES. The word "mandate" means charge, and is the term used to describe the authority under which certain territories and colonies, taken from the Germans and Turks in 1918, were entrusted by the LEAGUE OF NATIONS to some of the Allied nations. They were known as mandated territories. The governing nation undertook to protect the territory from its enemies, secure its good government, assist

in its development, and in time lead it if possible to self-government. In 1946, Great Britain, Australia and New Zealand were made trustees of these territories by the UNITED NATIONS ORGANIZATION.

MANDOLINE, a stringed instrument of which the strings are plucked by a plectrum and not by the fingers, thereby differing from the LUTE, the GUITAR, and the BANJO. Picture on page 404.

MANGANESE is a metallic ELEMENT used in many ALLOYS, particularly with steel, when it gives a hard, tough metal. Its compound potassium permanganate is a valuable disinfectant, and manganese dioxide is used as an oxidizing agent in the Leclanché cell. See BATTERY.

MANGLES and MANGLING. Adequate care in using a mangle will do much to lengthen its life. Before using, the tension screw or screws are tightened, and a bath to catch the water squeezed from the wet clothes is placed beneath, after use and before cleaning the tension screw is loosened. Wooden rollers should be washed only—scrubbing roughens them, metal parts should be periodically oiled. The roller and woodwork should be left dry and clean, and the whole machine covered.

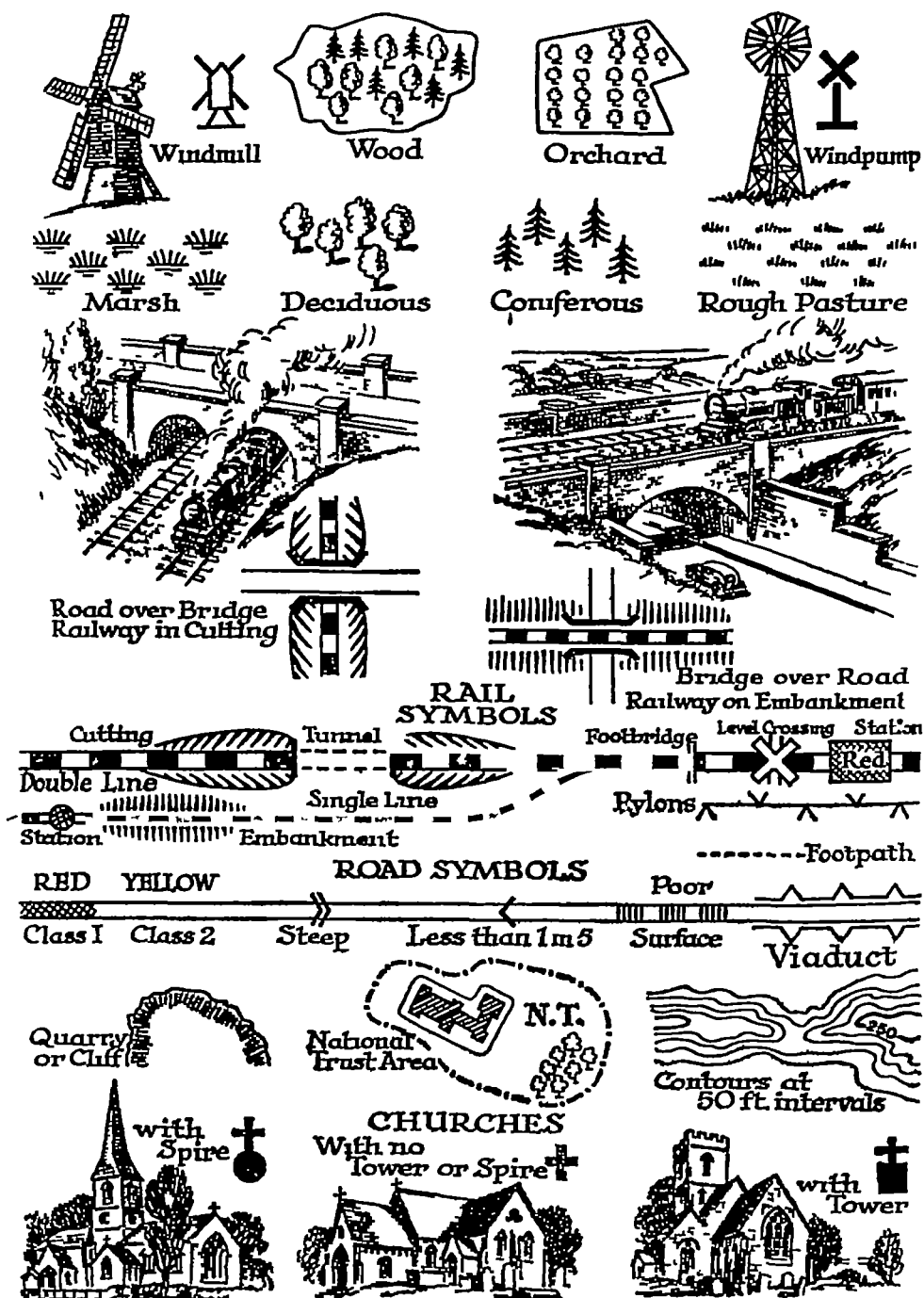
Flat articles like bed linen and certain plain garments may be finished by mangling when they are almost dry. In general, articles to be mangled should be evenly damp, stretched carefully into shape and folded right side out. Buttons and press studs should be protected from contact with the rollers and put through flat. Thick lumps of material should be avoided. After the tension screw has been tightened a fold of the article is placed to the rollers and passed through slowly; this is repeated two or three times.

low land through pale green and light brown to dark brown for high land. This is the layer-colouring method.

Some maps are constructed to show, in addition to relief and

rivers, climatic data, communications, distribution of population, and political divisions.

Maps are drawn to a SCALE, that is, each unit of length on the map represents a certain unit of length.



Conventional signs on maps and what they mean

of the actual area mapped. The 1-inch Ordnance Survey maps of Great Britain, for example, are drawn so that 1 inch on the map represents one mile on the ground. Large-scale maps like these show small areas in great detail, and conventional signs are used to represent local features, roads, landmarks, etc. A selection of the most useful of these signs is shown in the illustration. Small-scale maps give a general view of large areas. Other information given on maps is the direction of the North Pole, and the scale to which the map is drawn.

MARCONI, Guglielmo (1874-1937), was the Italian scientist and inventor who developed the practical and commercial applications of WIRELESS telegraphy.

MARCO POLO (1254-1323), a famous explorer who spent twenty-five years in Asia and wrote an account of his travels while in captivity. See EXPLORATION.

MARK, St., lived in Jerusalem, and went with Barnabas and Paul on the first missionary journey, but left them. Paul refused to take him again, so he went with Barnabas to Cyprus, but became friends with Paul again and worked with him in Rome. It is said that he acted as interpreter for St. Peter and became the first Bishop of Alexandria. Mark's Gospel was probably the first Gospel to be written (about A.D. 65) and used by St. MATTHEW and St. LUKE in writing their Gospels. Mark may have learnt much about the life of Christ from St. Peter to write in his Gospel.

MARKET, a place where buyers and sellers meet to buy and sell. It may be a retail market where all sorts of goods are bought and sold. It may be a specialized wholesale market where only one kind of article is bought and sold. Today,

most commodities have specialized markets, in London, for example, vegetables are sold in Covent Garden, fish in Billingsgate, meat at Smithfield, stocks and shares on the STOCK EXCHANGE.

In the more general sense, the word "market" can mean anywhere where there is a demand for goods.

MARLBOROUGH, Duke of (1650-1722) John Churchill, first Duke of Marlborough, served in Tangier (1667), and later married Sarah Jennings, a maid of honour to the Duke of York's daughter, Princess Anne.

In 1685, Churchill took an active part in suppressing Monmouth's Rebellion, for which service he was made major-general. Although he had sworn allegiance to James II, he also promised to help Prince William of Orange to win the crown. When Prince William landed in England, Churchill joined him. He was given an earldom, served in Flanders, and became commander-in-chief of the army.



Marlborough, famous general

Under Queen ANNE, Marlborough fought in the War of the Spanish Succession, and won his famous victories of Blenheim (1704), Ramillies (1706), Oudenarde (1708) and Malplaquet (1709). He had been created Duke of Marlborough at the beginning of the war, but his influence and that of his duchess was waning. Queen Anne dismissed the duchess from court, and on his return at the close of the war the duke was accused of misusing public money (which he stoutly denied) and deprived of his office (1711). On the accession of George I (1714), Marlborough was restored to his honours, but his health gave way two years later, and he retired into private life. He died in 1722, one of the greatest masters of the art of war.

MARLOWE, Christopher (1564-1593), was educated at King's School, Canterbury, and Cambridge. He was said to be an atheist, and a warrant was issued for his arrest in 1593. He was finally killed in a quarrel in a tavern in Deptford. Marlowe made blank verse (see PROSE) a medium for magnificent dramatic poetry. His heroes were like Tamburlaine, obsessed with lust of conquest, or like Dr Faustus, driven on by greed of knowledge and power to sell his soul for these things.

MARMOSET. See MONKEY

MARS (Greek Ares) is, in CLASSICAL MYTHOLOGY, the god of war and father of ROMULUS, the founder of Rome.

MARTINIQUE and **GUADELOUPE** are the largest French islands in the WEST INDIES, mostly forested mountain, and still subject to volcanic eruptions and hurricanes. The capitals are Fort-de-France and Basse-Terre. In 1946 they became overseas parts of France itself.

MARX, Karl. See COMMUNISM

MARY (the Blessed Virgin) was the Mother of Jesus, and is often called "Our Lady." She was wedded to Joseph, a carpenter of Galilee, in Christian belief, the father of her Child was the HOLY GHOST. She was present at the CRUCIFIXION.

MARY I (Mary Tudor, reigned 1553-1558), daughter of Henry VIII, became queen on the death of her half-brother, Edward VI, in 1553. The late king had been persuaded to make his cousin, Lady Jane Grey, his successor. But after being queen for nine days, Lady Jane had to give up the crown she had never wanted, and she was imprisoned in the Tower. The following year she and her husband were executed.

At first Mary had been popular with her subjects, but when she, a loyal Catholic, married Philip, King of Spain, and restored the Roman Catholic Church in England, she lost the nation's approval. Religious persecutions were common in those days and Mary's reign was marred by persecutions and burnings of Protestants. After a short reign of five years, Mary died, deserted by her husband and broken-hearted at the loss of Calais, England's last possession on the Continent, which was sacrificed in a war on behalf of Spain.

MARY II (reigned 1689-1694), was the elder daughter of James II. She had been brought up in the Protestant faith, and married her cousin, William, Prince of Orange. When James II lost the support of his subjects, they invited Mary and her husband to take the throne, and they were crowned the following year (1689). While her husband, WILLIAM III, was away on the Continent, Mary ruled the country. She died of smallpox in 1694, leaving no children.



Mary Queen of Scots returns to Scotland

MARY QUEEN OF SCOTS (1542-1587), Catholic daughter of James V of Scotland, was queen before she was a week old, her father having died soon after the Battle of Solway Moss. She was sent to France when she was six years old.

At the age of sixteen she married the Dauphin of France, who became king and died within two years of their marriage. Mary then returned to Scotland, and in 1565 married her cousin, Henry Stewart, Lord Darnley, who, like Mary, was one of the nearest heirs to the English crown. The marriage was an unhappy one. Darnley joined a plot to murder Mary's secretary and favourite, an Italian named

David Rizzio, and helped to carry out the deed in the queen's presence. A few months later Mary's son (afterwards James I of England) was born. The following year Darnley was killed by an explosion in a house, Kirk o' Field, Edinburgh, where he lay ill of smallpox. Not long afterwards, the queen married Lord Bothwell, who was suspected of having planned Darnley's death.

The Scottish nobles took up arms against Mary. She was defeated in battle at Carberry Hill, near Edinburgh, forced to give up

her crown to her infant son, and imprisoned in Loch Leven Castle (1567). The following year she escaped, raised a small army, but was again defeated at Langside. She escaped to England, hoping to get protection from Queen Elizabeth, her cousin. Elizabeth refused to see her, and for nineteen years Mary was a prisoner, moved from one English castle to another, and always the centre of Catholic plots against Elizabeth. At last Mary was accused of taking part in Anthony Babington's plot against the life of Queen Elizabeth. Mary was tried, and although she protested her innocence she was found guilty, and in 1587 she was executed at Fotheringhay Castle in Northamptonshire.

MASEFIELD, John (born 1875), is a novelist, playwright and **POET LAUREATE**. He ran away to sea while quite young, his experiences appearing in *Salt-Water Ballads* containing "I Must Go Down to the Sea Again," and in the two collections of short stories, *A Main-sail Haul* and *A Tar-paulin Muster*. Other poems are "The Everlasting Mercy," "The Widow in the Bye Street," and "Reynard the Fox." Among his plays are *The Tragedy of Nan*, *The Tragedy of Pompey the Great*, *Good Friday*, and *The Coming of Christ*.

MASS is a name for the Communion Service, used especially by Roman Catholics and some members of the Church of England. See **HOLY COMMUNION**.

MASTERSINGERS, guilds of poet-musicians existing in Germany from the 14th century onwards. They had very strict musical rules, and there were various ranks of performer, the highest being the "Master." They usually met in churches, and their compositions were mostly of a sacred nature. The last corporation was dissolved in 1839. **WAGNER** wrote an opera entitled *The Mastersingers of Nuremberg*.

MATHEMATICS deals with numbers and quantities, and the various things that can be done with them.

Arithmetic solves problems involving concrete quantities.

Algebra is a kind of abstract arithmetic in which letters are used



John Masefield, Poet Laureate

for quantities. With it we can solve problems that are difficult to solve by arithmetic only.

Geometry deals with the relationships of lines, angles of figures bound by straight lines, and circles. The methods of geometry are extended to solids: cones, prisms, pyramids, spheres, etc.

Conics deals with the geometry of ellipses, parabolas and hyperbolas, as ordinary geometry deals with circles.

Co-ordinate geometry is an application of algebra to geometry, equations being represented by mathematical lines.

Trigonometry is a development of the geometry of the triangle and is of great practical value for measurement and surveying; it carries calculations of angles and lengths much further than ordinary geometry, and makes great use of

similar triangles More advanced trigonometry is more closely allied to algebra, it deals largely with complex quantities Spherical trigonometry deals with the sphere, and is of importance to navigators

The *calculus* uses the limits toward which the ratios of infinitely small quantities approach to solve such problems as finding areas, tracing curves, finding maximum and minimum values

Details of certain of these subjects are dealt with separately under their respective headings

MATTER is a general name given by scientists to anything which can be weighed Thus we call starch, air, iron, water, muscle or blood matter, as opposed to light, heat and magnetism which we call non-material

The three forms of matter are solid, liquid, and gas Sometimes the same substance is easily converted from one form into another—compare ice, water, and steam

See also **ATOM**, **ELEMENT**, **MOLECULE**

MATTHEW, St, was a tax collector who became a disciple of **JESUS** St Matthew's Gospel was written about A D 70, probably for the use of Jewish Christians, and contains the great Sermon on the Mount

MAURITIUS is a British island colony in the Indian Ocean The capital is Port Louis Sugar is grown and is the principal export The Seychelles to the north are also British islands, yielding principally guano and cinnamon leaf oil

MEAT Wholesome meat should have no unpleasant smell, and the flesh should be firm and springy to the touch To test doubtful meat, push a skewer through to the bone, withdraw it, and smell the tip, if there is any disagreeable

odour the meat is unfit to eat The following table gives the points to look for in choosing meat

BEEF

Lean Red, slightly streaked with fat
Fat Pale cream in colour and not patchy

LAMB

Lean Red
Fat White and firm

MUTTON

Lean Red
Fat Yellowish, waxy

PORK

Lean Firm, finely grained, brownish red
Fat White
Rind Thin, smooth, cold to the touch

VEAL

Lean Pale in colour, firm in texture
Fat White

English meat is generally of better flavour than imported meat (though this is cheaper), and is usually very tender when cooked Imported meat should be wiped with a cloth wrung out in vinegar and water (2 tablespoonfuls of vinegar to 1 pint of water)

If uncooked meat has to be kept for a day or so in warm weather, it should be dusted with flour seasoned with pepper and salt, and hung in the larder if possible in a current of air and covered with muslin Choose the cut of meat best suited to the method of cooking, as follows **BOILING**—*Beef* silverside, brisket, and flank *Mutton and Lamb* leg, neck (scrag end), breast, and shoulder *Pork* leg, head, cheek, spring, loin, spare ribs and belly **ROASTING AND BAKING**—*Beef* sirloin, ribs, topside *Mutton and Lamb* leg, shoulder, loin, best end of the neck *Pork* loin, spare rib, leg *Veal* leg, shoulder and blade bone, loin, breast, heart **STEWING**—*Beef* steak, skirt, flank, silverside, oxtail, kidney, top ribs *Mutton and*

Lamb neck, breast, leg, head, trotters *Pork* belly, hand and spring, trotters, kidney *Veal* breast, shoulder, heart, best end of neck **GRILLING AND FRYING**—*Beef* undercut and rump steak, fillet *Mutton and Lamb* fillet of leg, loin chops, best end of neck, chops *Pork* loin chops, liver, fry *Veal* loin cutlets, chops from neck and fillet

The ways of cooking meat are.

(1) *Boiling*—this is cooking in a fairly large quantity of liquid, meat for this purpose should not be too fat The meat is put into boiling water and the boiling continued for 5 minutes, then a cupful of cold water is added, and the meat allowed to simmer until tender For simmering, about 30 minutes to the pound is allowed for beef and pork, 20 minutes for mutton and 25 for veal To extract some of the salt, salted meat is soaked in cold water, then put into fresh cold water, brought slowly to the boil, and allowed to simmer Ham is soaked in cold water overnight and scraped before cooking The water left over can be used for stock

(2) *Roasting and baking*—for this the oven should be heated for 15 minutes, then the meat is put in and cooked in a quick oven for 15 minutes, and after that more slowly For beef allow 15 minutes to the pound and 15 minutes over, for mutton 20 minutes to the pound and 20 minutes over, for pork, 30 minutes to the pound and 30 minutes over, for veal and lamb, 25 minutes to the pound and 25 minutes over Bones such as knuckles and bones left over from rolling should be cut off before cooking and used for soup

(3) *Stewing*—this is an economical method of cooking meat in a little liquid in a pan with a tightly

fitting lid The nutriment which comes from the meat is saved in the gravy, so there is no loss Little heat is used in cooking, for the stew simmers until it is tender, and it requires slight attention A stew must never boil, it is the long, slow cooking which makes the meat tender

(4) *Grilling*—a method of cooking on the grill of the gas stove The meat is prepared and placed on the grid below the grill when red hot, and turned every few minutes while cooking until it is tender

(5) *Frying*—this is cooking in a frying-pan in just enough fat to prevent the meat from burning

MECHANICAL ENGINEERING is the branch of engineering which deals with the means of producing power, its transmission and utilization It covers all types of fuels, boilers and engines, both steam and internal combustion, as well as their transmission, gearing and structural design

MECHANICS is the study of bodies and forces at rest and in motion, comprising **DYNAMICS** and **STATICS**

MEDICI, a famous family of bankers in the Italian city of Florence They flourished over many centuries and became powerful rulers, often using their great wealth for the good of the city

Cosimo Medici (1389-1464) encouraged great scholars, painters and sculptors to settle in Florence

Lorenzo Medici (1449-1492), Cosimo's grandson, founded an academy for the study of Greek manuscripts rescued from Constantinople before the city was captured by the Turks in 1453 This academy was largely responsible for the rapid spread over Europe of the ancient Latin and Greek literature See **RENAISSANCE**

Lorenzo Medici did much to encourage sculptors and artists, and had many Greek statues brought to Florence to be studied by pupils in a school for artists in one of his palaces. Among the most famous pupils in this school were Michelangelo and LEONARDO DA VINCI.

MEDITERRANEAN, the largest inland sea in the world, connected to the Atlantic by the Straits of Gibraltar and to the Red Sea by the Suez Canal. It forms part of the shortest sea route from north-west Europe to the Far East. See map of EUROPE.

MEDUSA. See GORGONS.



Megaphone helps the voice

MEGAPHONE, a trumpet-shaped instrument, which by concentrating the sound in one direction enables a voice speaking into it to be heard clearly at greater distances than without it.

MELODY, a tune or single-line combination of pitch and rhythm—the most easily heard and appreciated element in a musical work.

MENDELSSOHN, Jacob Ludwig Felix (1809-1847), was a German composer who often visited England. He composed "Elijah," the "Midsummer Night's Dream" music, "Songs without Words," the "Hebrides" overture, symphonies and many other works. His music can be so suggestive of the sounds of the natural world that he

has been called a great landscape painter in music.

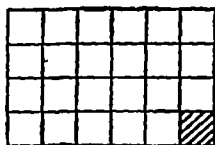
MENDING. Such small repairs as thin places should be darned with a cross-cut darn. All holes in linen, unless very small, should be patched. For a sheet the method of the calico patch is followed. For a hole in thick cloth, a cloth patch should be used. When the edges of linen show signs of wear, trim them and re-hem. See DARNING, HEMMING, PATCHING.

MENSURATION deals with the measurement of lengths, areas and volumes.

The perimeter of any figure is the distance round it. The perimeter of a triangle is the sum of the three sides, of a square or rhombus, four times the length of a side, of an oblong or a parallelogram, twice the sum of adjacent sides. The perimeter, or circumference, of a CIRCLE is $3\frac{1}{2}$ times the diameter, or $2 \times 3\frac{1}{2}$ times the radius. We often write this $c = 2\pi r$ (π pronounced *pie*, stands for $3\frac{1}{2}$ or, more nearly, 3.1416).

The AREA of a rectangle is length \times breadth, both being expressed in the same unit of measurement.

Here is a rectangle 4 inches by 6 inches (drawn to a reduced scale), 1 square inch of it is shaded.

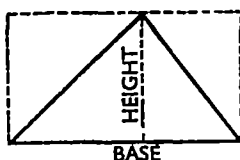


The area is $4 \text{ in} \times 6 \text{ in} = 24$ square inches. Similarly, the area of a rectangle 3.8 centimetres by 7.4 centimetres $= 3.8 \times 7.4 = 28.12$ square centimetres.

A **square** is a rectangle with equal sides, so the area is side \times side, or side squared. Area of square with side $3\frac{1}{2}$ inches $= 3\frac{1}{2} \times 3\frac{1}{2} = 7 \times 7 = 49 = 12\frac{1}{4}$ square inches.

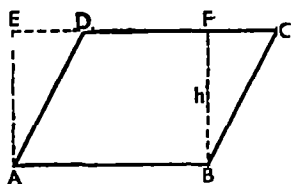
A **triangle** is half the rectangle on the same base, and of the same

height Hence
area of triangle
 $= \frac{1}{2} \text{ base} \times$
 vertical height
 Triangle with
 base 7 inches
 and height 5 inches
 $= \frac{1}{2} \times 7 \times 5$
 $= \frac{35}{2} = 17\frac{1}{2} \text{ sq in}$



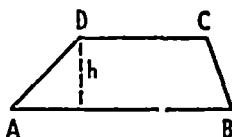
A *parallelogram* has the same area

as a rectangle on the same base and of the same height
 $ABCD$ is a parallelogram with



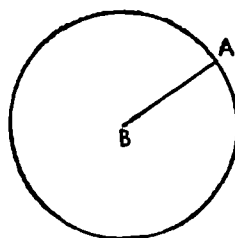
the equivalent rectangle $ABFE$, h is the height

A *trapezium*, a four-sided figure, with two sides parallel, has an area equal to half the height (the distance between the parallel sides) multiplied by the sum of the parallel sides
 $ABCD$ is a trapezium, h the height
 Area $= \frac{1}{2} h \times (AB + DC)$



Area of *walls* of a room = height \times length of all four sides, less the area of the doors, windows and fireplace

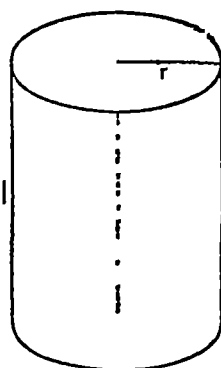
Area of *circle* $= \pi r^2$ or $3\frac{1}{2}$ times the square on the radius AB



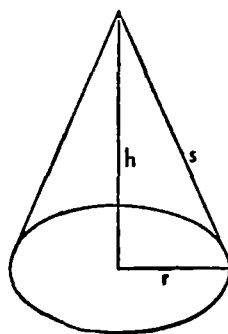
Radius $2\frac{1}{2}$ in, square on radius $= 2\frac{1}{2} \text{ in} \times 2\frac{1}{2} \text{ in} = 6\frac{1}{4} \text{ sq in}$
 Area of circle $= 3\frac{1}{2} \times 6\frac{1}{4} = \frac{22}{7} \times \frac{25}{4} = \frac{550}{28} = 19\frac{5}{14}$
 square inches

To calculate the surface area of a *cylinder*, the radius (or diameter) and the height need to be known
 Area of each end $= \pi r^2$ Circumference $= 2\pi r$ To find the area of the curved surface, imagine the cylinder rolled in paper, unroll the

paper and we get a rectangle one side = circumference of the cylinder, the other side = length of cylinder, area = circumference \times length of cylinder Thus the area of the curved surface $= 2\pi r \times l$



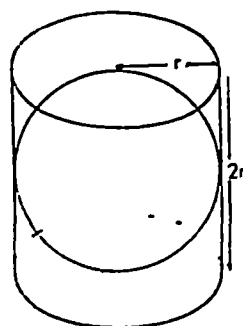
To calculate the surface area of a *cone* we need to know the radius of the base, and the vertical height or the slant height, that is r , and h or s Now $s^2 = h^2 + r^2$ (see



TRIANGLES), so if we know two of these, we can find the third
 Area of base $= \pi r^2$ To find the area of the curved surface we imagine it divided into a large number of triangles The

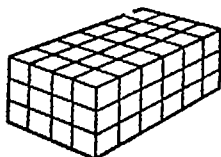
area of each is $\frac{1}{2} \text{ base} \times \text{height}$ (height of triangle = slant height of cone), so that the total area is $\frac{1}{2} \text{ height} \times \text{sum of bases}$ If the triangles are very narrow the sum of bases = circumference of cone
 So area of cone $= \frac{1}{2} \text{ slant height} \times \text{circumference} = \frac{1}{2} \text{ slant height} \times 2\pi \times \text{radius} = \pi \text{ slant height} \times \text{radius}$, i.e. πsr

The surface area of a *sphere* is exactly the same as that of the curved surface of a cylinder into which it will just fit The radius gives complete information

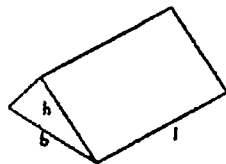


Length of cylinder = $2r$, circumference = $2\pi r$ Area of curved surface = $2r \times 2\pi r = 4\pi r^2$

For calculating VOLUME we need three dimension An oblong prism is 6 in long, 4 in wide and 3 in high, Its volume is seen to be $6 \times 4 \times 3$ inches, or length \times width \times height We can also write this volume as area of end \times length



A cube has all its edges equal Volume = edge \times edge \times edge, or edge cubed Volume = l^3 , where l is the length of an edge

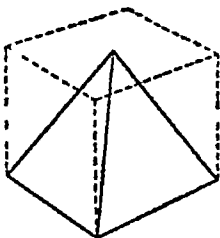


Volume of a triangular prism = area of end \times length = $\frac{1}{2}$ base \times height \times length = $\frac{1}{2}bhl$

Volume of cylinder = area of end \times length = $\pi r^2 l$

A pyramid is a solid on a flat straight-lined base, tapering to a point A square pyramid has a square base, a triangular pyramid a triangular base, and so on Volume of pyramid = $\frac{1}{3}$ volume of rectangular solid with the same base and the same height

This diagram shows a square pyramid in a square prism Volume of prism = area of base \times height Volume of pyramid = $\frac{1}{3}$ area of base \times height



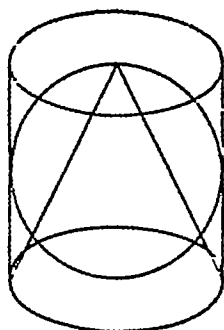
A cone is a circular pyramid, so its volume is $\frac{1}{3}$ area of base \times vertical height = $\frac{1}{3}\pi r^2 h$

There is an interesting comparison between the volume of a cylinder, and the volumes of sphere

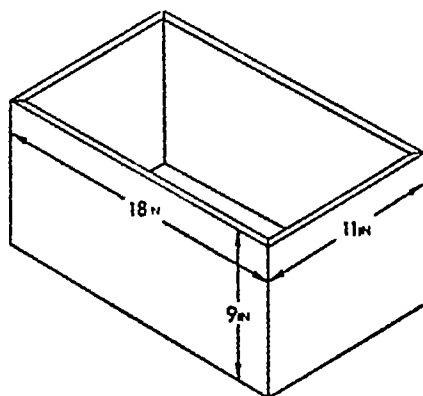
and cone which just fit into it

Cylinder sphere cone = 3 2 1

Volume of sphere = twice the volume of a cone = $2 \times \frac{1}{3}\pi r^2 h = \frac{2}{3}\pi r^2 \times h = \frac{2}{3}\pi r^2 \times 2r = \frac{4}{3}\pi r^3$



The diagram shows an open box, 18 in by 11 in by 9 in The wood



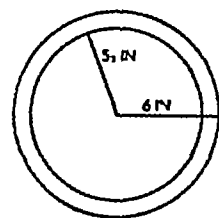
is $\frac{1}{2}$ inch thick The internal dimensions are length 18 in — $\frac{1}{2}$ in at each end = 17 in, breadth, 11 in — $\frac{1}{2}$ in at each end = 10 in, depth, 9 in — $\frac{1}{2}$ in at bottom = $8\frac{1}{2}$ in

The outside volume is $18 \times 11 \times 9 = 1782$ cu in The internal volume is $17 \times 10 \times 8\frac{1}{2} = 1445$ cu in The volume of the wood is $1782 - 1445 = 337$ cubic inches

A hollow sphere is a foot in diameter and the metal is $\frac{1}{2}$ inch thick The external volume is $\frac{4}{3}\pi r^3 = \frac{4}{3} \times \pi \times 6^3$ cu in The internal

volume is $\frac{4}{3}(5\frac{1}{2})^3$ cu in

The difference is the volume of metal = $\frac{4}{3}(6^3 - (5\frac{1}{2})^3) = \frac{4}{3} \times \frac{22}{7} \times 49\frac{1}{8} = 207\frac{29}{32}$ cu in



The general formula is $\frac{4}{3}\pi(R^3 - r^3)$ where R is the larger radius and r the smaller

MENTHOL is a white crystalline substance similar to camphor and obtained from oil of peppermint. It is used in medicine.

MERCURY (Greek *Hermes*) is, in CLASSICAL MYTHOLOGY, the messenger and herald of the gods.

MERCURY (quicksilver) is a metallic ELEMENT, liquid at ordinary temperatures. It is valuable because of its high density and its uniform rate of expansion under heat. Its compounds are very poisonous, but in the hands of the doctor form useful ingredients of certain medicines. See **BAROMETER** and **THERMOMETER**.

Many metals dissolve mercury to form "amalgams" which are used for such things as stopping teeth.

MERMAID, a mythical being supposed to live in the sea. She has a human head and body but is shaped like a fish from the waist down. The idea of the mermaid is now thought to have resulted from sailors catching distant glimpses of the **DUGONG**, a sea-cow, which floats half upright with its baby under its flipper.

MESOPOTAMIA. See **IRAQ**.

MESSIAH means "the anointed one" or "king." The Jews expected a divine prince to come who would be the perfect prophet, priest and king. Most thought he would be an earthly king and leader, but some thought he would suddenly come from Heaven. When Christ the Messiah came preaching the Kingdom of God, and called Himself "Son of Man," the Jews did not believe that He was the Messiah, bringing God's Kingdom, indeed, the orthodox Jewish religion still awaits the coming of the Messiah. **PETER**, realizing who **JESUS** was, said, "Thou art the Christ," for

Christ also means "the anointed one."

METAL, name given to a group of ELEMENTS with the following usual characteristics: (1) They are all of high density, and of high melting and boiling points. (2) They have a typical appearance that we associate with metals. (3) They are good conductors of heat and electricity.

A few metals, like sodium which has a low melting point and mercury which is generally liquid, may not satisfy all these requirements, but we classify them as metals as they have chemical properties consistent with those of other metals.

METAL, FABRICATION OF, includes all those processes by which metal is turned from rough blocks or slabs in which it is first produced to finished articles. The metal may be melted and cast in moulds which are near to the shape required, so that only a little machining is needed to finish it. Or it may be softened with heat, then rolled by machinery and cut into the required lengths, as in the case of steel bars, rods, and sheets.

Soft and thin metals are often shaped by being beaten with hammers or squeezed into shape in powerful presses. See **TOOLS**.

METALLURGY is the science dealing with the winning and purification of metals from their ORES, and with the ALLOYS of these metals.

METAMORPHOSIS is the change of form undergone by many creatures during growth. For instance, the **BUTTERFLY** begins life as a caterpillar (larva) which spins a cocoon round itself wherein it rests, and from this chrysalis (pupa) there suddenly emerges the full-grown insect. The tadpole living in water gradually changes to the **FROG** living partly on land.

METAPHOR. See **IMAGERY**.

METEOR, a body which circulates in space and becomes luminous when it enters the earth's atmosphere. It is often called a shooting star.

METEOROLOGY is the science which studies atmospheric phenomena in relation to weather and climate, enabling weather forecasts to be made. See **BAROMETER**, **CLIMATE**, **CLOUD**, **RAIN**, **TEMPERATURE**, **WINDS**.

METHANE is an inflammable gas composed of carbon and hydrogen, found in coal mines and, when mixed with air, the cause of explosions. It is present in ordinary coal gas. See **FIRE-DAMP**.

It is sometimes called "marsh gas" because it is formed from decaying vegetation and hence is to be found in bogs and marshy places.

METHODISTS are a Christian denomination started in 1739 by John and Charles **WESLEY**, who believed in the *method* of regular prayer and Bible reading. The Methodists believe in the historic creeds and also use **SACRAMENTS**. They are governed by a Conference. After Wesley's death several bodies of Methodists—"Wesleyan," "Primitive" and others—arose, but in 1932, all English Methodists united together to form "the Methodist Church."

METHYLATED SPIRITS, a liquid mixture of ethyl and methyl alcohol and pyridine together with a little paraffin and a dye. The paraffin and dye are added to make it difficult for it to be used in intoxicating liquors.

METRE. See **PROSODY**.

METRIC SYSTEM, a system of measurement in which units are based on multiples of ten, introduced first in France.

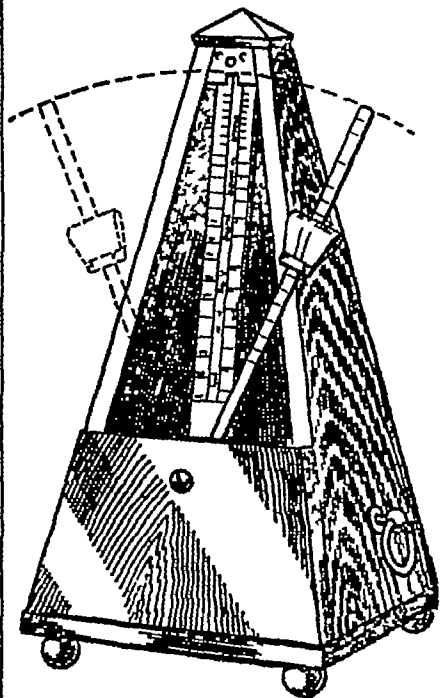
A distance supposed to be equal to one-forty-millionth part of the

circumference of the earth was taken as a standard, and called the metre. This was divided into the decimetre ($\frac{1}{10}$ metre), the centimetre ($\frac{1}{100}$ metre), and the millimetre ($\frac{1}{1000}$ metre). Further subdivisions can be made indefinitely. Multiples of a metre are the decametre (10 metres), hectometre (100 metres) and the kilometre (1,000 metres). The kilometre is about five-eighths of an English mile, while the metre is 39.37 inches.

The measurement for volume is the litre (about $1\frac{1}{2}$ pints), which represents 1,000 cubic centimetres.

The unit of weight is the gram, which is the weight of a cubic centimetre of water. A kilogram is 1,000 grams (about 2½ lbs). A metric ton is 1,000 kilograms.

METRONOME, a clockwork device, invented by Maelzel (1772-1838), with a movable weight on a pendulum, to enable one to judge



Metronome sets the pace

the pace at which a musical composition should be played Thus $MM = 100$ means that when the necessary adjustment has been made, Maelzel's metronome will tick 100 times a minute and the time between one tick and the next is how long a crotchet should last for that particular piece of music See NOTATION (MUSICAL)

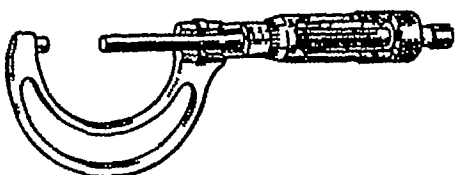
MEXICO is an independent republic of North America It consists of a great plateau, higher in the south than in the north, the lowland peninsula of Yucatan in the south, and the long, mountainous peninsula of Lower California in the west, divided from the rest of Mexico by the Gulf of California The west coast is subject to earthquakes The northern plateau is mainly desert and sparsely peopled Elsewhere sugar, wheat, maize and beans are grown, and there are very valuable silver and lead deposits On the coastlands west of Yucatan the main source of wealth is petroleum The chief towns are Mexico City, the capital, and the ports of Tampico and Veracruz The population is mostly mixed American-Indian and Spanish, Spanish is the official language Mexico is rich in remains of the ancient American-Indian civilizations

See map of **CENTRAL AMERICA**, which it adjoins

MEYNELL, Alice (1847-1922), was poet, essay-writer and critic With her husband she rescued from poverty the poet, Francis THOMPSON

MICA is a type of rock which splits into very thin translucent sheets It is an excellent electrical insulator, particularly where temperatures are high It is also used for the windows of slow combustion stoves, lamp chimneys and gas mask eyepieces among other uses

MICROMETER GAUGE, an instrument for the measurement of small lengths It depends on the



Micrometer gauge showing screw

movement of a very accurately made screw

MICROPHONE, an electrical device for turning variations in SOUND waves into corresponding variations in an electric current It is used in the TELEPHONE and in the WIRELESS broadcasting of speech and music

MICROSCOPE. The simple MAGNIFYING GLASS will give only a limited increase in size The compound microscope gives a much greater magnification and has two main lenses, the second of which magnifies still further the enlarged image formed in the first lens

The object, perhaps a thin slice of tissue or rock, is strongly illuminated by reflection from a mirror under the "stage" on which it rests, the light coming from the sun or a lamp Small objects are usually put on a strip of glass called a "slide"

The microscope is one of the most valuable instruments which the scientist has for investigating minute objects, plants and animals

MIDDLE AGES is the name given to the thousand-year period in the history of Europe from the fall of the Roman Empire to the beginnings of modern history (say A D 500-1500), but it is useful to treat the year 1000 as roughly the dividing line between the DARK AGES that followed the break-up of the Roman Empire—when the barbarians began to make them-

selves into the new nations—and the later Middle Ages when new ideas and better conditions began to dawn

In the Middle Ages there were two great powers in Europe—the Church and the Empire

Although the Roman Empire broke up, the city of Rome remained the centre of Christianity in Western Europe. From Rome missionaries travelled to Saxon England and elsewhere in Europe, and set up Christian churches under the leadership of the Pope or "Father"

At the end of the 8th century, Rome had been attacked by the Lombards, and Charlemagne, king of the Franks, went to the Pope's help. The Pope then revived the title of Roman Empire, and crowned Charlemagne as Emperor. This new Holy Roman Empire lasted in

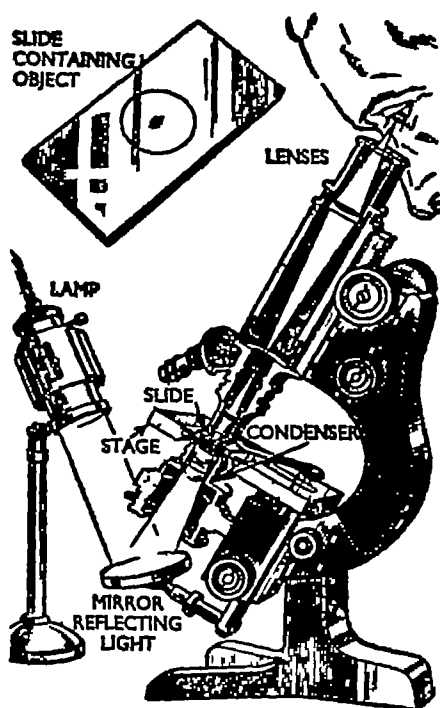
name at least down to Napoleon's time, and in the Middle Ages it included Germany and Italy. The Emperors were elected from among the Germanic princes, but the honour usually fell to a member of the Austrian royal family. So, it was said, there were two swords—the Sword of the Church and the Sword of the Empire, sometimes helping each other, sometimes opposing each other.

The Middle Ages were the Age of Faith. There were powerful Popes playing important parts in European affairs. It was the Age of CRUSADES, bringing new ideas, new knowledge of the world, and new trade to Europe. It was an age of great builders in stone, and saw the rise of magnificent cathedrals and abbeys. In the Middle Ages monks and nuns did much to atone for the lack of schools, hospitals, or institutions to care for the poor, the aged and the orphans. To the monks we owe the preservation and copying of books before the invention of printing.

Another great religious society was the Friars, or "Brothers." They travelled about, teaching the poor, helping the outcasts, and caring for the lepers. They did much good work both in Europe (including England) and in Asia, and they travelled as far as India and China in the Far East.

Nobles and princes employed minstrels—singers and musicians—to entertain their guests. The minstrels sang of heroes and fair ladies, of great deeds and noble lives, they kept old stories alive when books were scarce and very few could read. Tournaments were held where knights pitted themselves against each other in fierce combat.

The Middle Ages were also the ages of Pilgrims. Some travelled



Microscope and slide

overseas to the Holy Land, and returned wearing the "palm" grown there, others were content with a journey to an English or Spanish shrine, some managed to reach Rome. Fairs were then the great meeting places for business and pleasure and very important fairs were attended by merchants from other countries.

See also **FEUDAL SYSTEM**

MIGRATION. Some animals like the hedgehog avoid a season of unsuitable temperature and food scarcity by **HIBERNATION**, others, especially birds, by migration. Those that migrate journey to a place where conditions of life are better. Thus summer migrant birds, such as swallows, cuckoos and warblers, breed in Britain, but in autumn fly south to winter in a warmer country. Winter migrant birds, like fieldfares, flock to Britain in the cold months from their far northern breeding places. Partial migrants may fly only a few miles between their summer and winter homes. Many butterflies and moths migrate to England from Europe each summer. Sometimes rodents such as lemmings migrate in vast hordes in Scandinavia, and rat and mouse migrations sometimes occur. Locusts may migrate for hundreds of miles, and cause complete devastation where the flocks alight.

MILDEW. See **FUNGUS**

MILTON, John (1608-1674), was born in Bread Street, Cheapside, London. His father composed music, and aware from an early date of his son's unusual gifts, sent him to St Paul's School, and provided him with a private tutor. When Milton was sixteen he went to Christ's College, Cambridge, for seven years, where his reserve, among a lively set of students, as well as his personal

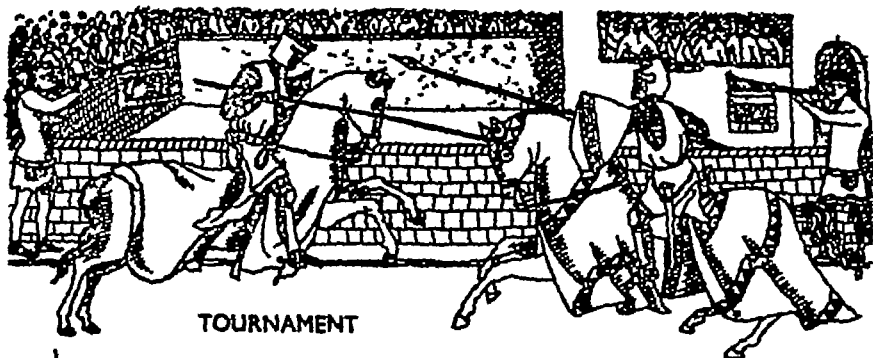
beauty, won him the half-sneering nickname "the Lady of Christ's." There he wrote his first well-known poem, the ode "On the Morning of Christ's Nativity."

When he left Cambridge he was uncertain what he wanted to do. He regarded poetry not as a means to a livelihood but as a sacred calling, and was permitted to live with his father for six years at Horton, in Bucks, reading widely in Greek, Latin and Italian, and writing.

To this period of seclusion from the world belong "Lycidas," an elegy (see **POETRY**) on the death of a college friend, and *Comus*, a masque (see **DRAMA**)—poems which show in him a lofty morality, high purpose and great ambition.

In 1638 Milton travelled abroad, chiefly in Italy, but in 1639 he returned to England, where civil war was threatening. He took pupils in his London home, beginning with his two nephews, and became interested in ecclesiastical controversies. He was strongly on the side of Parliament, becoming in effect Cromwell's foreign secretary and giving many years to prose writing in which he defended the republic in a book called *Eikonoklastes*, and the trial and execution of King **CHARLES I.** The work and strain led to his total blindness. His first marriage in 1643 to a seventeen-year-old girl of Royalist family was an unhappy one, and a second marriage in 1656 was ended very soon afterwards by the death of his wife.

In 1660 with the restoration of the Stuart Monarchy and the return to power of the friends of the Crown, Milton's liberty and even life were in danger in view of his republican past. He was allowed to live in peace, however, marrying Elizabeth Minshull in 1662 and moving to a

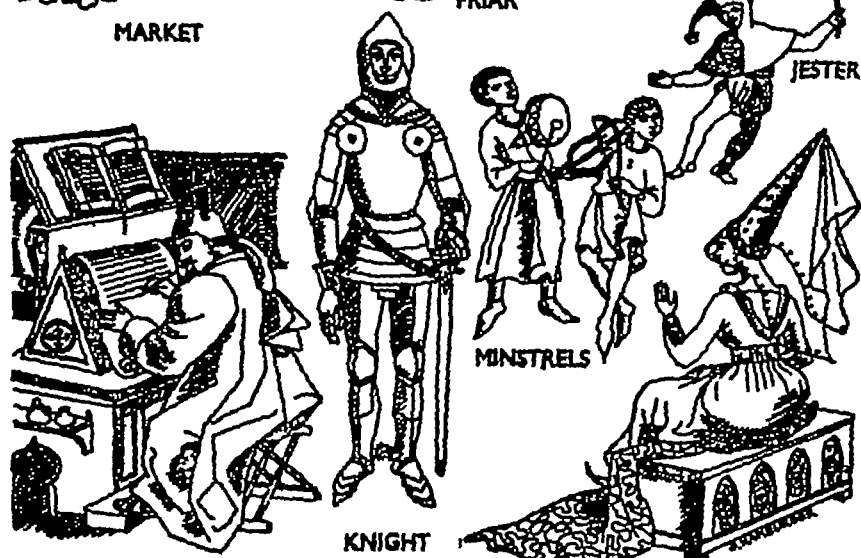


TOURNAMENT



MARKET

FRIAR



JESTER

MINSTRELS

KNIGHT

SCHOLAR MONK

LADY OF THE MANOR

People you would have seen if you had lived in the Middle Ages

house near Bunhill Fields, London, where he died in 1674 (They lived for a time in a cottage at Chalfont St Giles, during the Great Plague of London)

Milton's great epics, *Paradise Lost* and *Paradise Regained*, were written in these closing years, as was also his poetic drama in imitation of Greek tragedy, *Samson Agonistes*. He is an eloquent poet,



Milton when a young man

appreciative of the pleasures and graces of life, as is apparent in his early "L'Allegro," but choosing deliberately a life of austerity and high effort

MIMICRY. In biology this term refers chiefly to the unconscious imitation shown by many creatures, especially by insects. For instance, a vividly marked butterfly, because it has a bitter taste, is not eaten by birds. Another butterfly which is a tasty morsel may have developed very similar markings, and so be confused with the first one. The first benefits by having a bad taste, the second benefits through mimicry of the first's markings. Mimicry is closely associated with protective

resemblance. See also CAMOUFLAGE

MINE, a weapon consisting of a steel shell and filled with high explosive used mainly against shipping. An explosion takes place when a ship either touches or passes near the mine, and the explosion may be strong enough to sink the ship

There are several types of mine. A *contact mine*, which is anchored to the sea-bed by means of a long steel cable, explodes when anything strikes one of the projecting horns with which this type of mine is fitted. A *magnetic mine*, often dropped by parachute from an aeroplane, is set off by the influence of a ship's magnetism, for all ships become magnets while they are being constructed, owing to the effect of the riveting and hammering of the steel plates of which they are made. An *acoustic mine* is operated by the sound vibrations in the water caused by the beating of a ship's propellers

MINERVA (Greek Athene) is, in CLASSICAL MYTHOLOGY, the goddess of wisdom, arts, sciences, poetry, weaving, etc

She is sometimes presented as the goddess of war

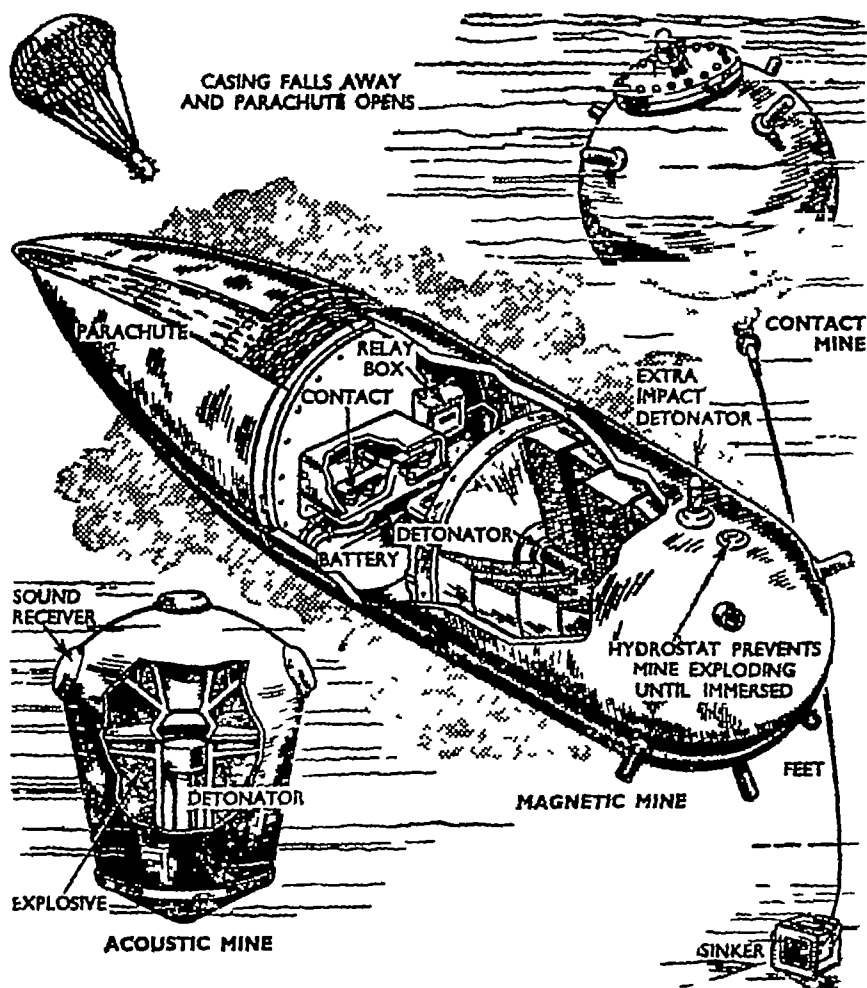
MINK. See FLESH-EATING MAMMALS

MINOTAUR is, in CLASSICAL MYTHOLOGY, a monster kept by Minos, King of Crete, in a labyrinth made by DAEDALUS, it was killed by THESEUS of Athens

MINSTREL. See MIDDLE AGES, TROUBADOUR

MINUET, an old dance with three slowish beats in the bar, often included in a SUITE. Later its form was used in the symphony. See FORM IN MUSIC

MIRACLE, an occurrence which is remarkable in being contrary to scientific understanding of what happens in the world. There are



Mines used against shipping in the Second World War

three possible explanations (1) The circumstances of the "miracle" may have been wrongly reported or misinterpreted—the miraculous element might disappear in the light of more detailed information (2) Our scientific knowledge of what *can* happen in the world may be inadequate, and with greater knowledge the "miracle" may be capable of natural explanation (3) The miracle may be due to some *supernatural* intervention in earthly affairs Thus Christianity teaches that the divine power of Christ

worked many miracles, especially those of healing, to show the love of God, and that the greatest miracle of all is Christ's RESURRECTION

MIRAGE, an optical illusion common in deserts, but also seen in a long street on a hot day. The hot ground gives off heat very rapidly to the air nearest to it, this hot air expands and, owing to its lower density, light from the distant sky is bent to the observer's eye and gives the impression of water shimmering on the ground

MISSIONARY, one who is sent abroad to spread a religious message among people to whom it is unknown. Thus Christ sent His followers to spread Christianity throughout the world, the pioneer Christian missionary being St PAUL. Among missionaries of long ago were St PATRICK, St AUGUSTINE, and St AIDAN. Missionary work increased from the early 19th century onward, and famous modern missionaries include David LIVINGSTONE, Mary Slessor, and Father Damien, a Belgian priest, who worked in Hawaii among the lepers until he died of their disease.

MITE See SPIDER

MIXTURES and COMPOUNDS. Generally speaking, substances in the same state can be *mixed* together in any proportions, and such a mixture can often be separated again by simple physical means like SOLUTION and DISTILLATION. When, however, the ELEMENTS of the substances *combine* together to form a compound, they do so in certain fixed proportions, and heat energy is given out or taken in. The compound has properties completely different from those of the original elements, and can be split up into its elements only by vigorous chemical action often involving the supplying of energy. For instance, hydrogen and oxygen are gases which combine to form water, a liquid, and in so doing give out a lot of heat energy. To break up the water, electrical energy has to be supplied and then the water changes into the two gases again.

MODE, a musical scale or succession of notes. In classical music only two modes were used, known to us as the major and the minor SCALE, but others are found in old choral music and in FOLK-SONG. Now composers are seeking variety

by reviving some of these old modes. One, the Dorian for example, can only be obtained by playing from D to its octave on the white notes of the piano.

In arithmetic a mode is one form of AVERAGE.

MODELLING. Plasticine, clay, newspaper and paste can all be used for this. Plasticine is the easiest and cleanest to use. See also PAPIER MÂCHÉ CRAFT.

If you model animals or birds, try to go to a park or a zoo and make drawings of the animals you have chosen. Notice details of the limbs, how the legs grow from the body, and what main characteristics to reproduce in your model. If you find drawing difficult, take snaps or buy photographs of the animal and study them while modelling.

Use a board to model on in clay so that you need not disturb the work once started. If you have to leave your work unfinished, cover it with a damp cloth. Take small balls of clay and push them together till the main body shape has been produced. Then add more balls for the head, limbs, etc. Start with a sitting or crouching animal, as long, clay legs will not support a body unless they have wire reinforcements. A duck is an easy subject to start with. When you have built up the shape smooth it over with a damp finger or with a curved modelling tool. If you are going to have the model fired or baked in a kiln, when it is dry hollow out any extra clay from inside, otherwise it may burst when subjected to great heat. If you cannot get it fired, coat it with paint when it is dry and give it a coat of clear varnish. This will help to stop it from crumbling.

MOHAMMED (570-632), who was born in the Arabian town of Mecca, founded the Mohammedan

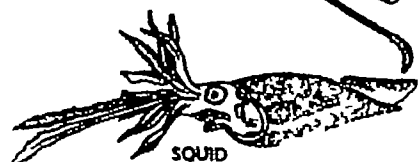
(or Islamic) religion, a member of which is called a Moslem God is called Allah Islam teaches "There is no God but Allah and Mohammed is his prophet", it does not believe in idol-worship, but preaches the worship of one God by prayer five times a day, and fasting at fixed times The religion was spread by "holy wars" and established in India, the Near East and North Africa The place of worship is called a mosque The holy book of Mohammed's teaching is called the Koran See also CRUSADES

MOLE See INSECT-EATING MAMMALS

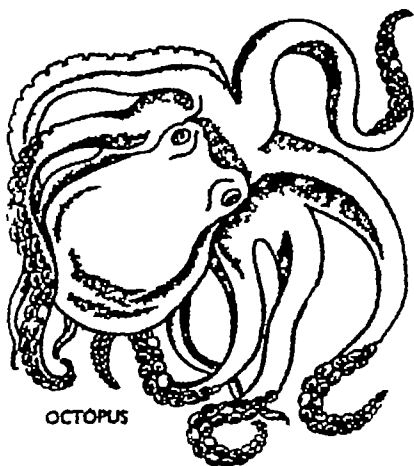
MOLECULE, the smallest portion of a substance that can main-



CUTTLE FISH



SQUID



OCTOPUS

Largest of the molluscs

tain a separate existence and yet keep the special properties of the substance It is built up from a fixed number of ATOMS which are of the same or different kinds The chemical formula for a substance expresses the number and kind of atoms which form its molecule For instance, the molecule of water, H_2O , contains two hydrogen atoms and one oxygen atom, the molecule of ozone, O_3 , contains three oxygen atoms See also ELEMENT

MOLIÈRE, Jean Baptiste Poquelin (1622-1673), one of France's greatest playwrights, wrote comedies heaping ridicule on the deep-rooted failings and pretensions of certain types and classes of people, such as *L'Avare* (The Miser), *Les Femmes Savantes* (The Bluestockings) and *Le Malade Imaginaire* (The Hypochondriac)

MOLLUSC, the name applied to members of a large group of backboneless animals including snail, cockle and octopus types The snail type has a shell in one piece, often spirally coiled In the cockle type (bivalves) the shell has two halves, held together by a hinge and tough tissue The octopus, cuttlefish and squid have a hidden shell (the "cuttle-bone" given to canaries) or none at all

Molluscs have soft bodies and move by a muscular foot Snails, slugs, winkles, whelks, limpets, etc., creep on a broad, flat foot They have definite heads, with eyes, sensitive tentacles and a mouth with a rasping tongue Some are vegetarian, others flesh-eating Bivalve molluscs regulate the opening of their shells by strong muscles, and can put out a narrow foot for movement. They have no head, and food is sieved from a current of water continually passing over GILLS and mouth The octopus class has



MUSSEL

Threads by which
Mussel fastens itself



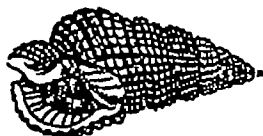
LIMPETS



WINKLES



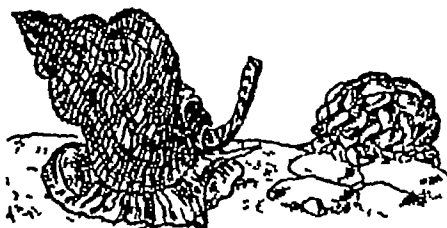
TOP SHELLS



DOG WHELK



OYSTER



WHELK AND EGGS

Inside of shell



COWRIE



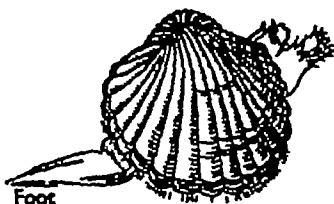
TURRET
SHELL



SCALLOPS



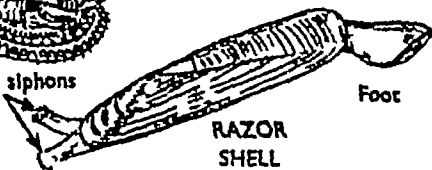
Eyes



Foot

COCKLE

Breathing alphonos



RAZOR
SHELL

Foot



CLAM

Molluscs have been useful to man as food, money and ornament here are some that you are likely to find on the seashore

the foot divided up to form eight or ten arms set with suckers to catch prey. Sepia ink is formed from cuttlefish ink-bags, used by the mollusc to make smoke-screens. The octopus lurks in crevices, catching crabs, while the cuttlefish and squid swim rapidly in shoals to hunt fish. All three have parrot-like beaks and large eyes. The octopus can swim rapidly backwards by forcing a jet of water through a narrow funnel.

All sea molluscs breathe by gills, land forms by a lung, while fresh water forms may use either method.

Molluscs have been and are, of great importance to man, as food, primitive money, and utensils, sources of dye and mother-of-pearl, while some oysters form pearls by covering irritating grit particles with shell material.

MOLUCCAS. See **EAST INDIES**

MONACO is an independent principality on the Riviera coast. Its main source of revenue is the world-famous Casino in the town of Monte Carlo.

MONASTERY, a building where **MONKS** live. The monastic life grew up in Europe about the 4th century, and was organized largely by St. Benedict. Monasteries were founded in great numbers between 500 and 1500. In England, the dissolution of the monasteries occurred in the reign of **HENRY VIII**, but new ones were started later.

MONEY can be anything that has the power to buy. When a primitive community has advanced to the economic stage where it can begin to exchange its goods, it is faced with the difficulty that it has no medium of exchange. If, for example, one group wishes to exchange fish for meat, then no one knows how much fish is worth so much meat. So there emerges a

medium of exchange, let us say iron. Both communities want iron. Both know the value of their goods in terms of iron. If six fish are worth one bar of iron of a fixed length and a leg of lamb is also worth the same bar of iron, then six fish can be exchanged for one leg of lamb. It becomes the medium through which the exchange can be effected.

In the course of history, many things have been used for money—shells, slaves, cattle, iron, gold, and silver. Today, as well as silver and copper coins, we have legal paper money. Of course, nobody wants bits of paper, they are useless on a desert island. But in the same way nobody wants actual money, we want what the money will buy. These paper notes, printed by the government, can be exchanged for what we really want—goods and services.

Different countries have different units of money. In Britain it is the pound, in America the dollar, the mark in Germany, the rouble in Russia, the franc in France.

See **BANK** and **CURRENCY**

MONGOLIA, INNER See **CHINA**

MONGOLIA, OUTER, is an independent republic adjoining **CHINA**, the Mongolian Peoples Republic, consisting mainly of a high plateau rising in the west, with part of the Gobi Desert across the south. It is well watered, and contains the source of several great rivers. Most of the people are **NOMADS** with herds of sheep, horses, camels and oxen. Wool and hides are exported. The capital is Ulan Bator Khoto. See map of **CHINA**.

MONGOOSE. See **FLESH-EATING MAMMALS**

MONK, a man who lives a religious life in a **MONASTERY** in an

order or fellowship of monks. He always takes three vows (1) not to marry, (2) to obey the abbot or head monk, (3) to give up all his possessions and live in poverty. The first monks lived about A.D. 350. During the MIDDLE AGES the monks did great work by founding churches, preaching, teaching and writing, but afterwards many monasteries became rich and worldly. There are different orders or kinds of monks. St. Benedict founded the Benedictine Order, St. Bruno the Carthusian. The plain dress which a monk wears is called a habit.

MONKEY, an animal belonging with APES and man to the highest order of MAMMALS. Man is not descended from monkeys, but many million years ago he probably came from the same stock. See EVOLUTION.

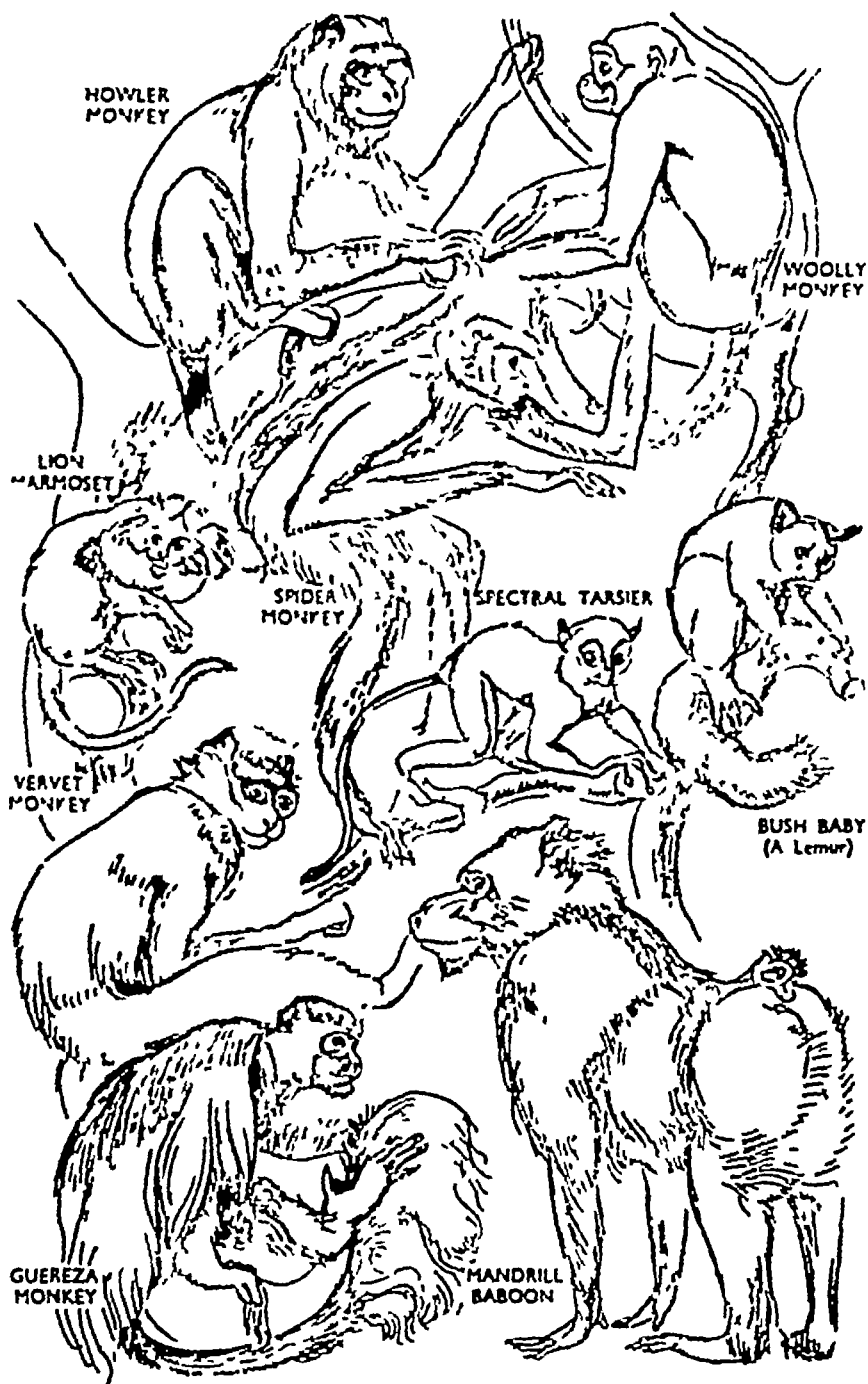
Marked differences are found between the monkeys of Africa, India and farther east, and those of Central and South America. Old World monkeys have nostrils set closely together, and many have brightly coloured patches of skin on their faces and hindquarters. Baboons often show vivid blue and red colours. They live in troops in rocky country and walk on all fours. The old males are very savage. Vervets, langurs and mangabeys are well-known. Old World monkeys. The New World monkeys have flattened nostrils set wide apart, and prehensile tails by which they can hang. Woolly, spider and howler monkeys, and the small capuchins, are typical of South America. Marmosets are very primitive small monkeys. Lemurs, whose centre is Madagascar, are the lowest forms. They are very small, with huge eyes and ears, and are active at night. Little South African bush-babies are charming creatures when they have been tamed.

MONKEY AS A PET. Monkeys are not very satisfactory pets because they are delicate and cannot be house-trained. Since they catch cold very easily the cage must be absolutely free from draughts. It should be boarded on three sides and be big enough to enclose a dead branch or two for climbing on and a shelf with plenty of hay or straw to sleep in.

Monkeys need a varied diet of fruit, porridge, hard-boiled eggs, bread, mealworms, insects and a small amount of shredded raw meat.

If your monkey mopes or seems otherwise out of sorts, consult a vet. It may need a special diet. In any case, monkeys are so prone to a variety of diseases that they need immediate medical attention the moment they appear to be unwell.

MONOPOLY is the control of any purchasable product or service to such an extent that the holder of the monopoly can decide the selling price without fear that competing firms, by selling at a lower price, will upset his market. For example, certain large firms engaged in manufacturing the same article might agree *not* to compete among themselves, and might sell their goods at prices which they had agreed on as being very profitable to themselves, together they could obtain a virtual monopoly of that product and, once they did so, might be in a position to make very high profits for their own shareholders at the public's expense. Such a monopoly ends the conditions of competition. If and when monopoly conditions exist for the benefit of private companies, the public may have to consider whether such power and such benefits should not be controlled by the State for the common good of all.



Monkeys form part of the highest order of mammals there are marked differences in form, size and habits between the various types

This brings us to the second main type of monopoly—State or Government monopoly—in which a product such as coal or the facilities for a service such as railways or the postal services are nationally owned, and therefore the monopoly of the State. The management of such Government monopolies, their efficiency, cost of operation and price of their product or services to the public can at any time be queried in Parliament, whereas the conduct of a monopoly in private hands tends to remain a private concern.

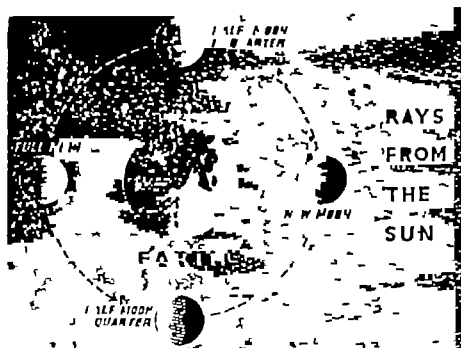
There are also minor forms of monopoly. An author or composer, for example, enjoys a monopoly of his own work and can make his own conditions for its sale. He is protected by the laws of COPYRIGHT. An inventor, too, by patenting his invention secures a monopoly of its sale, and can himself make and sell the product or sell to some manufacturer the right to make and sell it.

MONROE DOCTRINE. See UNITED STATES

MOON, a body about one-fiftieth the size of the earth. It turns on its axis once a month and in the same time goes round the earth, its distance from the earth is about a quarter of a million miles. Light from the sun falls on it and is reflected on to the earth.

The phases of the moon depend on how much we can see of the side which is lit up by the sun, and this depends on where the moon happens to be in its journey round the earth.

As far as we can tell, the moon has no atmosphere and the differences of temperature between its night and day must be extreme. The fact that no water is present on it means that life as we know it cannot exist on the moon. The attraction of the moon is responsible



Phases of the moon

for our TIDES. See also ECLIPSE

MOORS, a mixed race living in the north of Africa, were converted to the Mohammedan or Moslem faith in the 7th century. Under the leadership of Tarik, they crossed the narrow strait to Spain, and took the rocky fortress which they named Gebel-al-Tarik, "the rock of Tarik," which we call Gibraltar.

In seven years they had reached the Pyrenees, and they overran the south of France until driven back by Charles Martel at Poitiers in 732. From 756 Cordova was an independent Moorish kingdom. The city of Cordova contained a wonderful mosque built between 780 and 992. Other fine specimens of Moorish architecture are still to be found in the Alhambra, the ancient fortress and palace of the Moorish kings of Granada.

The Moors were highly civilized, and in the study of mathematics, science and philosophy were far in advance of the people of Europe at that time. It is largely through the Moors and Arabs that the culture and civilization of the ancient world has been preserved. The Moors were clever agricultural workers, and made canals to carry water to their orchards and gardens. Through the Moors in Spain the art of paper-making and the science of algebra (an Arabic word) were brought into Europe from the East.

The Moors were not driven out of Spain till the close of the 15th century

See also MOHAMMED

MOOSE, a HOOFED MAMMAL with large wide antlers, allied to the deer. It lives in the cold swampy forests of North America, and in North Europe too, where it is usually known as the elk. See the picture on page 294

MOROCCO, in North Africa, consists of a French PROTECTORATE, a smaller Spanish one, and the International Zone of Tangier. The Sultan is the nominal ruler but the real authority is in the hands of the protecting Powers. Phosphates and other minerals, cereals and fruit, eggs and hides are exported from French Morocco, and iron ore, lead and skins from Spanish Morocco. The capitals are Rabat (French), Tetuan (Spanish) and Tangier (International). Casablanca and Agadir are important ports. See the map of AFRICA

MORPHIA (morphine) is a white crystalline drug extracted from opium and used to cause sleep or make people insensitive to pain. See ANAESTHETIC

MORRIS, William (1834-1896), a man of many gifts, was poet and artist, designer and decorator, manufacturer and printer, and

socialist as well. In 1861, with Rossetti and Burne-Jones, he founded a firm of manufacturers and decorators, the work of which, in the production of beautifully designed fabrics and FURNITURE, changed English taste very considerably. In 1884 he, with some others, organized the Socialist League. The Kelmscott Press, for the production of finely printed and decorated books, he founded in 1890, designing its type.

He was an excellent story-teller in verse and prose. In 1867 appeared *The Life and Death of Jason*, a re-telling of the Greek legend, while *The Earthly Paradise* is a collection of Greek and Scandinavian legends. He translated into English verse many of the Icelandic sagas. His later writings were in prose, the romances including *The Story of the Glittering Plain*, and *The Well at the World's End*. He also published two romances, *The Dream of John Ball* and *News from Nowhere*, in which his idea of SOCIALISM is really the theme.

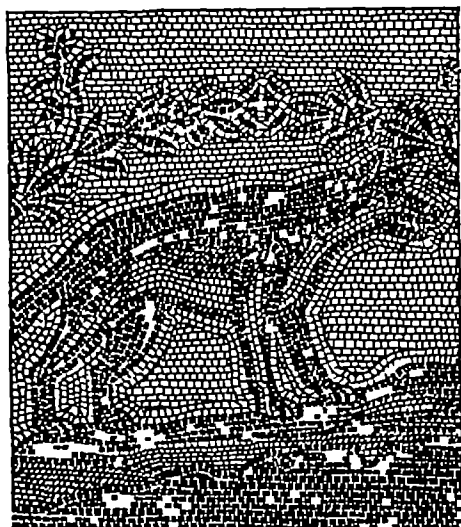
MORSE CODE is the telegraphic code in which various combinations of dots and dashes represent letters of the alphabet and numbers. It was invented by Samuel Morse (1791-1872), an American.

A	• —	N	— •	1	• — — — — —
B	— • • •	O	— — — —	2	• • — — — —
C	— • — • • •	P	— • — — •	3	• • • — — —
D	— — • •	Q	— — — • — —	4	• • • • — —
E	•	R	• — — •	5	• • • • •
F	• • — — •	S	• • •	6	— — • • • •
G	— — — •	T	— —	7	— — — • • •
H	• • • •	U	• • — —	8	— — — — • •
I	• •	V	• • • — —	9	— — — — — •
J	• — — — — —	W	• — — — —	0	— — — — — —
K	— • • — —	X	— • • • — —		
L	• — — • •	Y	— • • • — — —		
M	— — — —	Z	— — — • •		

IN LENGTH OF SIGNAL A DASH IS EQUIVALENT TO THREE DOTS

Morse code used in telegraphy was invented by Samuel Morse

MOSAIC is a form of decoration consisting of small pieces of coloured stone, glass, and sometimes metal, set into cement to cover surfaces of walls or floors in such a way as to form a pattern or even picture



Mosaic built up of small pieces

It was used extensively by the Romans, and by Byzantine artists to decorate the walls of their churches in the 12th to 16th centuries

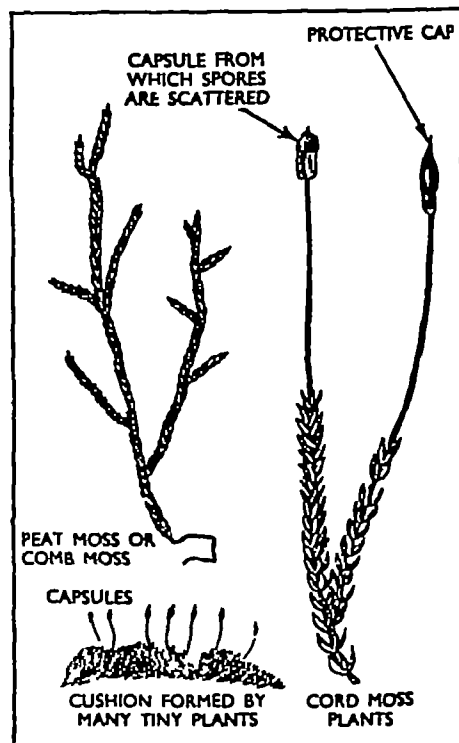
MOSES was the prophet who is venerated as the founder of the Jewish religion. As a baby he was found in the rushes by the River Nile and adopted by the daughter of Pharaoh. He fled to Jethro, and **JEHOVAH** called him to deliver his enslaved fellow Israelites. After the first **PASSOVER** Feast, the people were set free from Pharaoh by Jehovah. Moses led them to Mount Sinai, where Jehovah made the **COVENANT** with His people. There they received the Commandments, and the other laws set forth in the Bible and still kept by the Jews, and used the tabernacle-tent and the Ark, or sacred chest, as a sign of the presence of Jehovah. The Israelites always remembered that

Jehovah had delivered them from Egyptian rule, and that Moses was the Law-giver. Moses led his people east of the Dead Sea to the Plains of Moab, but when he was so close that he could actually see the Promised Land he died.

MOSLEMS. See **CRUSADES**, **INDIA**, **MOHAMMED**, **MOORS**

MOSQUITO, a blood-sucking **FLY**. Certain species spread **MALARIA**. Great efforts have been made of recent years to control the mosquito, by destroying the larvae by spreading oil over the surface of the ponds in which they breed, thus stopping the new mosquitoes from breathing, or better still, by improved drainage.

MOSS, a group of low-growing plants related to the **LIVERWORT**. They are higher than **ALGAE** in the plant kingdom, but lower than the **FERN**. Each plant bears leaves, but has no flowers or true roots. They bear small reproductive cells, which



Moss showing spore capsules

unite to produce spore capsules which remain attached to the parent plant. The spores are scattered to form new plants. Some mosses normally live in woodland, others select rocks, walls, trees, bogland.

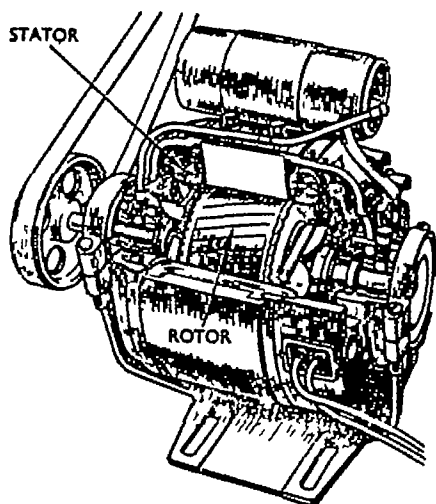
MOTOR, a machine which turns some other form of energy into mechanical energy. It is a term also used for the internal combustion **ENGINE**.

MOTOR CAR. See **CLUTCH**, **DIFFERENTIAL GEAR**, **ENGINE**.

MOTOR, ELECTRIC. The action of all electric motors depends upon the reaction between two magnets, one fixed and the other free to turn about its middle point. The movable magnet, the rotor, has a current passing through the wire wound round it (see **ELECTRO-MAGNET**), and turns so that its north pole is near the south pole of the fixed magnet, the stator. By changing the north pole of the movable magnet into its south pole, and its south pole into its north pole, we cause this magnet to rotate and point in the other direction, and by constantly reversing this polarity the rotor is kept spinning round, and so turns a wheel to drive a belt, etc. The polarity is reversed by reversing the direction of the current passing through the wire round the rotor.

MOULD, in *engineering*, a shape in sand or other non-fusible material into which molten metals are poured so that when the metal hardens it has a new prearranged form. See **BLAST FURNACE**, and **METAL (FABRICATION OF)**. Moulds of metal and other materials are used for making articles with the new **PLASTICS** the plastic when in its hot and pliable stage is forced into the mould, where it cools and hardens into its new shape.

In *botany* a mould is a form of **FUNGUS**.



Inside the electric motor

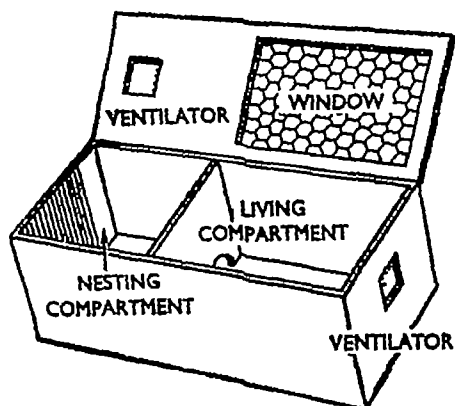
MOULT. Many animals shed their skin, hair or feathers at intervals. This is moulting. It may be necessary to allow for growth, or for repair, or for a seasonal difference. Furry **MAMMALS** may shed much hair before growing a thinner spring or thicker winter coat. **BIRDS** moult feathers especially after the breeding season. **SNAKES** and **LIZARDS** may shed the outer skin complete, and **FROGS**, toads and newts moult a delicate skin at intervals. Animals without backbones, such as **CRABS** and **INSECTS**, need to cast off their complete outside skeleton at each moult and have a defenceless period while the pale, soft and much larger new covering hardens and darkens.

MOUSE. See **RAT**.

MOUSE AS A PET. Keep your cages in a dry, well-ventilated room. Each must be soundly built so that no wild mice can enter. Mice are sociable but quarrelsome. You must therefore separate them into colonies of three or four in each cage. Have all your cages uniform. Place them on tables or trestles round the walls, leaving the floor

clear to make recapture as easy as possible

There are various types of cages on sale at pet stores, but a useful general model that can easily be made at home is illustrated. The netting and perforated zinc should be held firmly in place with staples



A comfortable home for tame mice

A sheet of glass may be laid over the netting at night to prevent draughts and the onslaughts of wild mice

Cover the floors of both compartments with a thick layer of sawdust. Fill the nesting box with hay or fine shavings or other such material

The sawdust must be changed two or three times a week and the whole cage emptied, dried and disinfected once a month.

Give your mice two meals a day: canary seed in the morning and white oats at night, with a little warm bread and milk every other day and an occasional scrap of raw meat. Do not forget to give them greenstuff as well—grass heads, lettuce, slices of apple and carrot—but do not offer too much at one time and remove all uneaten portions. Oily food—linseed, nuts and cheese—should be given sparingly.

The age of does for breeding is between fourteen weeks and one

year. Pen two or three does with one buck and when one is seen to be with young, the others must be moved and a supply of soft paper scraps and fine hay provided for a nest. Do not disturb the new family for at least five days. Then you may examine them if your hands are clean and free from the smell of other mice. Keep three or four of the most promising and leave them with the doe for four or five weeks, after which the sexes must be separated. A doe should not be allowed to rear more than three litters a year.

Their chief diseases are (1) Eczema and scurvy: increase the amount of green food and sprinkle a little sulphur on the bread and milk. (2) Ringworm: treat with diluted tincture of iodine.

MOUTH ORGAN. See REED INSTRUMENTS

MOZAMBIQUE is a Portuguese colony on the east coast of Africa. It is mostly lowland, and has a hot, damp climate along the coast. Sugar, maize, cotton, copra and sisal are exported. Beira and Lourenço Marques, the capital, are important ports and are calling stations on the Cape sea route to the East. See map of the UNION OF SOUTH AFRICA.

MOZART, Wolfgang Amadeus (1756-1791), one of the very greatest of composers, was taken when a child by his father round the courts of Europe to play on the harpsichord. Later he became a member of the Archbishop of Salzburg's household, was dismissed, and went to earn a precarious living in Vienna. He became a famous composer of symphonies and sonatas (see FORM IN MUSIC), improving on the ideas of HAYDN, and also of OPERAS. His compositions are very numerous, they are full of happy and graceful melodies.



Mozart was a great composer, here he is seen conducting one of his own works from the harpsichord, before a fashionable audience

MULTIPLICATION is a short means of adding a number of equal quantities or numbers together 7×4 might be worked by setting down four 7's and adding them up

When we know that $7 + 7 + 7 + 7 = 28$, we can say "four sevens are 28," and so we change addition into multiplication

When we add 0 to the right side of a number we multiply it by 10 $37 \times 10 = 370$ To multiply by 20 we add 0 and multiply by 2, and so on

When we add 00 to a number we multiply it by 100, 000 multiplies it by 1,000, and so on Thus

38	75
40	700
<u>1520</u>	<u>52500</u>
96	57
4000	90000
<u>384000</u>	<u>5130000</u>

To find $567 \times 8,034$, we have to multiply by 8,000 (add 000 and multiply by 8), by 30 (add 0 and multiply by 3), and by 4 We then add the three products

567	
8034	
<u>4536000</u>	($\times 8000$)
17010	($\times 30$)
<u>2268</u>	($\times 4$)
<u>4555278</u>	($\times 8034$)

$567 \times 8,034$ may be regarded as 8,034 rows of 567 It may also be regarded as 567 rows of 8,034, so that $567 \times 8,034 = 8,034 \times 567$ To put it in general terms $xy = yx$ $7 \times 8 \times 9$ means 7×8 , and then the product (56) multiplied by 9 $7 \times 8 \times 9 = 56 \times 9 = 504$ Equally $7 \times 9 \times 8 = 63 \times 8 = 504$, $9 \times 8 \times 7 = 72 \times 7 = 504$

There are various ways of multiplying money Thus, to find

$\pounds 1 \ 3s \ 4\frac{1}{2}d \times 56$
 (1) $56 = 7 \times 8$, so we can multiply by 7 and then the product by 8 Or by 8 and then by 7, this is better because multiplication by 8 gets rid of the pence

\pounds	s	d
1	3	$4\frac{1}{2}$
		8
	9	7 0
		7
<u>$\pounds 65$</u>	<u>9</u>	<u>0</u>

(2) $\frac{1}{2}d \times 56 = 28d$ Set down 28 under d $56 \times 4 = 224$ Set down and add to 28 = $252d = 21s$ with no pence over

Set down 21 under s and write $0d$ in the answer $56 \times 3 = 168$ Set down and add to 21 = $189s = \pounds 9 \ 9s$

\pounds	s	d
1	3	$4\frac{1}{2}$
		56
	9	21 28
	<u>56</u>	<u>168 224</u>
	<u>65</u>	<u>189 252</u>
<u>$\pounds 65$</u>	<u>9</u>	<u>0</u>

Set down 9 under \pounds , and write $9s$ in the answer $1 \times 56 = 56$, add to 9 = 65, and write $\pounds 65$ in the answer

(3) This method is called practice It is most suitable when the shillings and pence form easy fractions For example

$15s = 10s + 5s = \frac{1}{2} \text{ of } \pounds 1 + \frac{1}{2} \text{ of } 10s$
 $12s = 10s + 2s = \frac{1}{2} \text{ of } \pounds 1 + \frac{1}{2} \text{ of } 10s$
 $14s = 10s + 4s = \frac{1}{2} \text{ of } \pounds 1 + \frac{1}{2} \text{ of } \pounds 1$
 $7s \ 6d = 5s + 2s \ 6d = \frac{1}{2} \text{ of } \pounds 1 + \frac{1}{2} \text{ of } 5s$
 $8s \ 4d = 5s + 3s \ 4d = \frac{1}{2} \text{ of } \pounds 1 + \frac{1}{2} \text{ of } \pounds 1$, and so on

\pounds	s	d
56 at $\pounds 1$	56	0 0
56 at $3s \ 4d$ ($\frac{1}{2}$ of $\pounds 1$, hence $\frac{1}{2}$ of $\pounds 56$)	9	6 8
56 at $\frac{1}{2}d$	2	4
<u>$\pounds 65$</u>	<u>9</u>	<u>0</u>

(4) When we have learnt how to decimalize money (see DECIMALS)

we write £1 3s 4½d as £1 16875, and then multiply by 56 The resultant decimal part will need to be reconverted into shillings and pence

$$\begin{array}{r} \text{£}1.16875 \\ 56 \\ \hline 58\ 43750 \\ 7\ 01250 \\ \hline 65\ 45000 \\ = \text{£}65\ 9s \end{array}$$

In the following algebraic example, multiply each term in the top line by a , then by $-2b$, then add the products When multiplying, $+$ multiplied by $+$ gives $+$, and $-$ multiplied by $-$ gives $+$ But $+$ multiplied by $-$ gives $-$ See POSITIVE AND NEGATIVE

$$\begin{array}{r} a^2 - 2ab + b^2 \\ a - 2b \\ \hline a^2 - 2a^2b + ab^2 \\ - 2a^2b + 4ab^2 - 2b^2 \\ \hline a^2 - 4a^2b + 5ab^2 - 2b^2 \end{array}$$

MUSCLE is the device by which messages from the brain are translated into movement of the body It forms the body's flesh, the "lean meat," and consists of bundles of very fine, elastic fibres A muscle at rest is long and limp, but at work it contracts, so pulling on the tissues to which it is fastened Many muscles are attached at one end to a bone, and at the other to a non-elastic tendon, which is fastened to another bone beyond a joint When the muscle contracts

its pull is passed to the tendon, which moves the second bone in relation to the first Muscles of this type work in pairs, one contracting, for example, to extend the arm, while the one which bends it relaxes

Muscles are either voluntary, like those which move leg or arm, or involuntary, like those causing movements of the digestive organs Both types contract on receiving messages by nerves from the brain

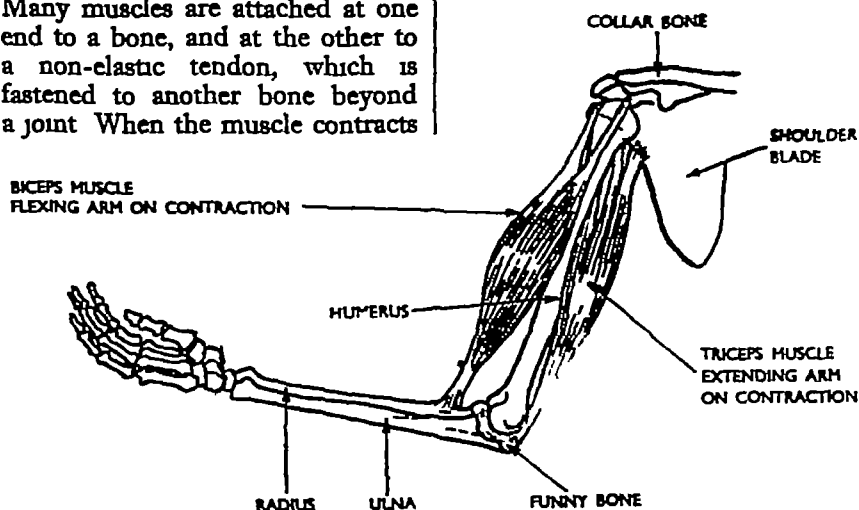
Muscles at work use energy, give out heat, and form waste See also NERVOUS SYSTEM and DIGESTION

MUSES, in CLASSICAL MYTHOLOGY, the nine goddesses in charge of the arts and sciences Their favourite haunts were Mount HELICON and Mount PARNASSUS

MUSICAL INSTRUMENTS

See BAGPIPE, BANJO, BRASS WIND INSTRUMENTS, FIFE, FLUTE, GUITAR, HARMONIUM, HARP, MANDOLINE, ORCHESTRA, ORGAN, PERCUSSION, PIANOFORTE, REED INSTRUMENTS VIOLIN, WOODWIND

Most of these instruments are illustrated on pages 404-405



One muscle extends the arm and the other bends it

H. Cummings

BANJO

VIOLIN

VIOLA

DOUBLE BASS

GUITAR

BOW

CELLO

MANDOLINE

UKULELE

BAGPIPE

TENOR DRUM

BASS DRUM

KETTLE DRUM

SIDE DRUM

HARP

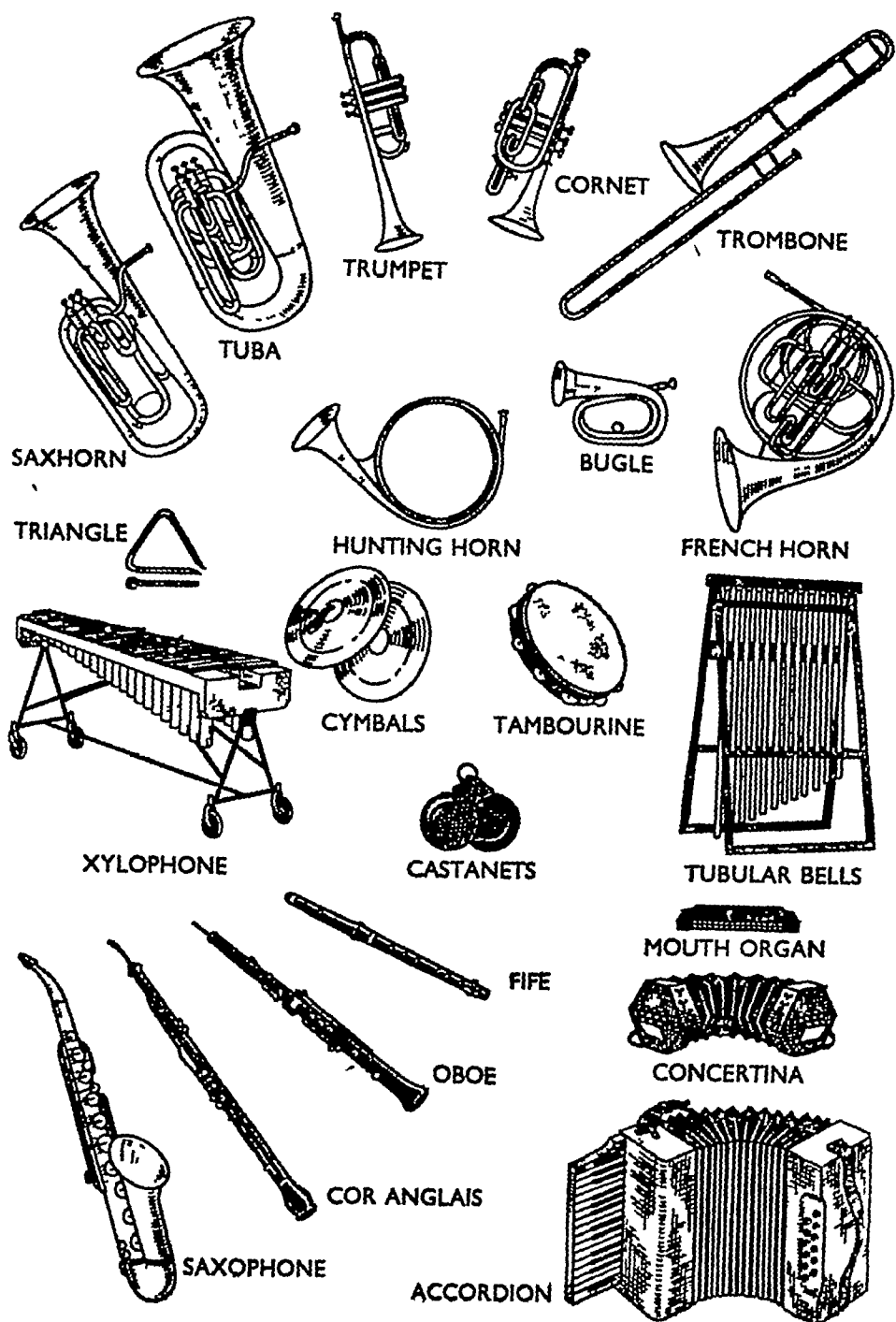
PICCOLO

FLUTE

CLARINET

BASSOON

These musical instruments are arranged here in groups, the smaller



instruments have been drawn proportionately larger than the others

MUSICAL TERMS. The following are the commonest terms you are likely to meet

accelerando, getting quicker
adagio, slow
allegro, fairly fast
andante, slowish
cantabile, in a singing style
crescendo, getting louder
da capo, repeat from the beginning

diminuendo, getting softer
forte, loud
largo, slow and dignified
legato, smooth
piano, soft
presto, quick
rallentando, getting slower
staccato, sharp, detached
vivace, lively

MUSIC, HISTORY OF. The Hebrews used music in the Temple services, the Egyptians had musical instruments; and the Greeks evolved a system of music theory. All early music was melody, the melodies of the early Christian Church are known as PLAINSONG because they had no regular rhythm. Then melodies were combined, and thus the art of COUNTER-POINT grew up. This gave rise in the 16th century to a great school of polyphonic CHURCH MUSIC, with its many strands of interwoven melody. Outside the Church, secular music was spread far and wide by travelling minstrels. When the rules of church music were applied to domestic music, there was formed the MADRIGAL, and from this the AYRE.

In the 17th century a new art form was developed in Italy—this was the OPERA, drama set to music, with the characters singing their words instead of speaking them. This helped the new idea of music being primarily one definite melody with other notes played merely to enrich that melody. See HARMONY

There was at the same time a great advance in instrumental playing: people played on their own or in orchestras, and SUITES of pieces were performed everywhere.

In the 18th century came the greatest composers of this pure classical music, with its long instrumental and orchestral compositions in many movements, each movement to a set FORM. See BEETHOVEN.

In the 19th century came a new idea: music was written to illustrate some famous scene, character, or event, and was descriptive. Such music is called PROGRAMME MUSIC, and the early composers who wrote it were the ROMANTIC SCHOOL. The later Romantic composers were strongly influenced by the rising tide of European nationalism, and made much use of national tunes and dances. See GRIEG. This nationalism is seen also in WAGNER's mighty music dramas, the most advanced form of opera the world had yet known.

Modern composers of today are seeking new forms of musical expression, using quarter-tones, new SCALES, new harmonies, new RHYTHMS, and it sometimes all sounds very strange to our ears, not yet used to this new music.

MYTHOLOGY is the name given to the whole body of legends that have grown up round the ancient gods and heroes. They were handed down by word of mouth, varying with different tellers so that different versions of the same story are frequent. Some of the heroes of myth and legend may perhaps have been real people, whose prowess was celebrated in story, exaggerated, and in time explained by attributing to them supernatural powers, their real characters being lost in the many retelling of the tales.

See also CLASSICAL MYTHOLOGY

N

NAPHTHA is a mixture of **HYDROCARBON** liquids, obtained from petroleum or from **COAL DISTILLATION**. Both types are inflammable.

NAPHTHALENE is a white solid obtained from coal tar distillation. It is a **HYDROCARBON**. As "moth balls," "carbon balls," or "camphor," it is widely used to protect clothes from the attacks of moths.

NAPOLEON BONAPARTE (1769-1821) was born in Ajaccio, Corsica, and was educated in military schools at Brienne and Paris. He won his first military distinction at the siege of Toulon in 1793, fighting for the new French Republic. See **FRENCH REVOLUTION**. Two years later, when Paris was once more in an uproar, he turned his cannon on the rioters and cleared the streets with "a whiff of grape-shot." In 1796 he gained fame in

Italy, utterly defeating the Austrians and Sardinians.

Napoleon then planned a drive eastward, and obtained leave to attack Egypt, as a stepping-stone to India. He captured Malta on the way, took Alexandria, and won the Battle of the Pyramids, but the destruction of the French fleet by **NELSON** in the Battle of the Nile completely upset his plans.

Returning to France in 1799, Napoleon found the Government in a bad state, and placed himself at the head of it as First Consul. In 1804 he crowned himself Emperor of the French. Then followed a series of great victories, including Ulm, Austerlitz and Jena, but his plans for invading England had been ruined by Nelson's naval victory at Trafalgar in 1805.

In 1812 Napoleon tried to conquer Russia, but was forced to



Napoleon rallies his troops during the Battle of Waterloo

retreat from Moscow WELLINGTON was fighting against him in Spain and France In 1814 Napoleon surrendered, and was sent a prisoner to Elba He escaped the following year, returned and ruled for the "Hundred Days" He was finally defeated by Wellington at Waterloo in 1815, and died in exile on the island of St Helena His body was later brought to Paris for burial

NARCISSUS is, in CLASSICAL MYTHOLOGY, a beautiful Greek youth who, falling in love with his own reflected image, pined away and was changed into the flower which bears his name

NATIONAL ANTHEM, a song in praise of a nation or its ruler and adopted as the official tune of the country

"God Save the King" became Britain's national anthem in the 18th century, its origin is in some doubt, but it has become one of the most famous of all national anthems, and its tune has been used in other countries With different words it has been the national anthem of Switzerland, Denmark, and Germany until 1918 In the United States it is the tune of a famous national song beginning "My country, 'tis of thee"

NATIONAL ASSEMBLY, one Chamber of the French Parliament, the other being the Council of the Republic The members of the National Assembly are elected by the people direct, the members of the Council of the Republic by local councils It is the members of the two Chambers who elect the President of the French Republic, and he appoints a prime minister to govern the country The prime minister and his ministers must answer to the National Assembly for their conduct of State affairs

NATIONAL DEBT. Like individuals, States try to make their

income or revenue meet all their expenditure This is not always possible, for in times of war a State has to spend vast sums on armaments To enable it to do this the State borrows money usually from its members, and if there is a series of wars the debt of the nation may grow to a huge figure In times of prosperity States try to save money and use the saving to pay off part of the debt See also TAXATION

NATIONAL INSURANCE in respect of health, unemployment, and pensions is part of the social legislation which is such a feature of 20th-century history in Britain It began with the Old Age Pensions Act of 1908, but since then several Acts have extended the scope of the INSURANCE and the benefits The principle behind them all is the same, namely, contributions by the worker, the employer, and the State The worker's share is deducted from his weekly wages by his employer, who is responsible for seeing that the card or book recording payment is properly stamped The worker puts his name on a doctor's list, and receives free treatment when he is ill Pensions are paid through the post office Unemployment benefit is paid at employment exchanges

NATIONAL SOCIALISM, or Nazism, the name given to the anti-democratic political movement in GERMANY headed by Adolf Hitler Like FASCISM in Italy, it had its origin in the condition of the country after the First World War The party, whose uniform was a brown shirt, attained power by the votes of the people, but once established as the governing party with Hitler as effectual dictator all other parties were abolished Thus it was impossible for the government to be unseated save by war

or revolution The Reichstag was retained as a one-party parliament, but it met very rarely, and then only to listen to speeches from Hitler or leading members of the party The Nazis maintained their power through a secret police called the Gestapo, and the laws were re-made to serve the needs of the ruling party No opposition to Nazism was tolerated The Press and radio were turned into means of maintaining Nazi power and individual liberty was strictly controlled Persecution of the Jews, who were made the scapegoat of all past ills, was a feature of the system, but its main end was to build up military power for a war of conquest When the war came the Nazi victories were so many and rapid that it looked as though their plans might succeed in full, but with their ultimate defeat by Britain, Russia and the U S A the Nazi power was destroyed, its leaders tried and hanged for their many crimes and its petty sup-

porters driven to conceal their past

See also **TOTALITARIAN STATE**

NATURAL GAS is the gaseous part of **PETROLEUM** which often issues from cracks or bore holes in oil-bearing areas The gas is largely **METHANE** and is used for power and lighting In some places it contains **HELIUM**

NATURALISM in literature is an attempt to give the full effect of truth by superabundance of detail—an attempt to give the photographic truth

NATURALIZATION, the act of admitting an **ALIEN** or foreigner to the privileges of citizenship in his adopted country

NAVIGATION is the art and science of setting a safe course and maintaining a ship or aircraft on it from one place to another

The ship's navigator may rely upon all or any of the following prominent landmarks, **LIGHTHOUSES** or lightships, the magnetic or gyro **COMPASS**, the speed of the ship, the positions of the sun and stars,

and radio beams from fixed transmitting stations

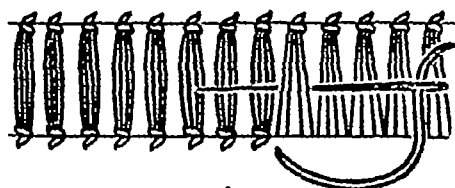
The aircraft navigator has been greatly helped also by the modern development of **RADAR**

NEAR EAST, that part of Asia nearest Europe It covers **TURKEY**, **SYRIA** and **LEBANON**, **PALESTINE**, **ARABIA**, **PERSIA** and **IRAQ** This part of the world is sometimes included in the wider term—"Middle East"

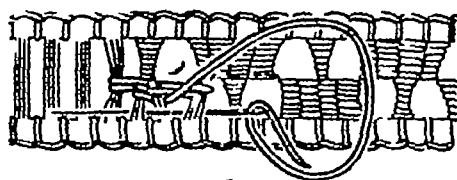


Countries of the Near East

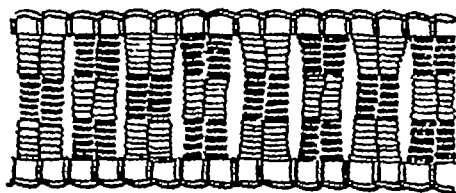
NEEDLEWEAVING is a form of decorative needlework in which threads of the material are drawn out, and embroidery threads are woven in to take their place. Loosely woven materials such as linen or crash should be chosen for this work, the threads used should be rather thicker than those withdrawn. A blunt-pointed needle is required. Strong colours give the



1



2



3

Needleweaving can be very decorative

best effect. All complicated designs should be worked out first on squared paper.

When the threads have been withdrawn, the top and bottom of the border is **HEM-STITCHED** (see 1) by this means the whole is divided into bundles of four threads and is ready for the decorative stitch to be worked. Each block is made by weaving backwards and forwards over two, four, or six bundles of threads (see 2). It is inadvisable to draw threads to a depth greater than 1 inch, otherwise the threads become slack and difficult to handle. At the end of each row the ends

of the weaving are caught to the fabric. Another example of needleweaving is shown in (3).

NEEDLEWORK consists of various crafts such as plain sewing (see **HEMMING, SEAMS, STITCHES**), **EMBROIDERY, KNITTING, DARNING** and **CROCHET WORK**. Plain sewing is used to make and mend clothes. Embroidery, which entails a knowledge of design and colour and the technique of embroidery stitches, is used in the decoration of clothes and household articles. A wide variety of garments can be knitted or crocheted—stockings, gloves, dresses, sports coats, jumpers, and hats, as well as household articles and lace for table cloths, etc.

Good equipment is essential, the light should come over the left shoulder, needles should be slightly thicker than the thread to be used with them. Short needles are used for plain sewing, darning needles should be much longer and have large eyes. You also want embroidery needles, crochet needles—bone for wool and steel for cotton, knitting needles of steel and bone; large scissors for cutting big pieces of material, a small pair with sharp points for embroidery, a thimble, pins and pincushion, a workbasket and a needlecase. No plain sewing should be done without a thimble. If much plain needlework is done a sewing machine is invaluable.

NEHEMIAH was Jewish cup-bearer to the Persian King Artaxerxes. Nehemiah obtained permission to go and help to rebuild Jerusalem, and led the work of rebuilding the walls in 444 B.C. after the **BABE**.

NELSON, Horatio (1758-1805) entered the Royal Navy as a midshipman in 1770. His first voyage was to the West Indies. Later he spent some time in the Arctic Ocean. He commanded the *Agamemnon* in



Nelson puts the telescope to his blind eye

the siege of Toulon (1793) when Britain was fighting the new French Republic. The next year, in the siege of Calvi (Corsica), Nelson lost the sight of one eye.

Nelson fought under Jervis in the battle off Cape St Vincent, and became rear-admiral. In 1797, at Santa Cruz, Teneriffe, his right arm was shattered by a shot and

was amputated. Nelson feared his career was ended, but the next year he defeated NAPOLEON's fleet in Aboukir Bay (Battle of the Nile). In 1801 he took part in the Battle of Copenhagen (Baltic) under Sir Hyde Parker. When that commander feared defeat and signalled, "Cease Action," Nelson put his telescope to his blind eye and said

"I see no signal, go on fighting," and so won this important battle

In 1805 Nelson followed the French and Spanish fleets across the Atlantic to the West Indies, and finding they had turned back he quickly followed. On 21st October, 1805, he fought his last battle off Cape Trafalgar. He hoisted his famous and immortal signal "England expects that every man will do his duty." Nelson was fatally wounded by a shot fired from the rigging of an enemy ship, and died a few hours later.

NEON LIGHT If a current at high voltage is passed through the gaseous element neon at low pressure, it produces a bright orange glow. The gas is contained in long tubes and used for advertisement purposes.

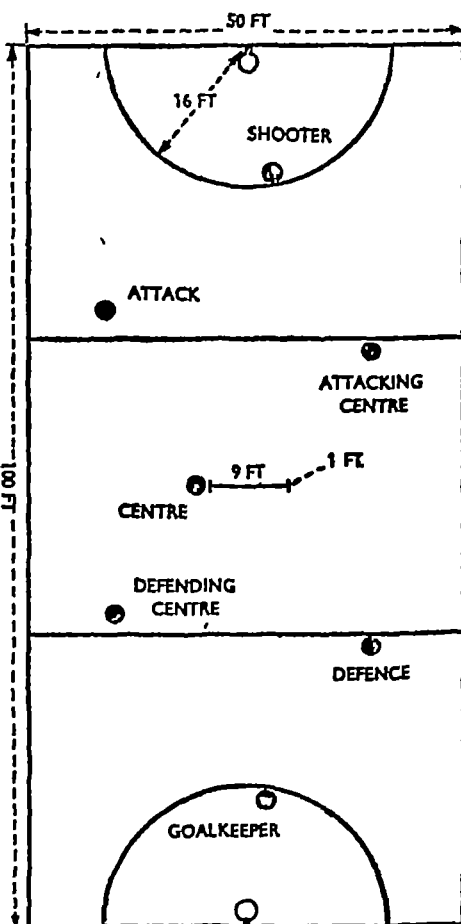
NEPAL is an independent kingdom north of India, lying among the Himalayas and including Mount Everest (over 29,000 feet—the highest mountain in the world) within its boundaries. Most of the country is forested or mountainous, but rice, millet, tobacco and oil seeds are grown in the valleys. See map of INDIA.

NEPTUNE (Greek Poseidon) is god of the sea in CLASSICAL MYTHOLOGY.

NERVOUS SYSTEM This is the arrangement of nerves and brain which enables a person or animal to see, hear, smell, taste, touch—in a word, enables one to make all his contacts with the surrounding world. All animals from worms upwards possess a well-defined nervous system, of which that of man is the most complex. The human brain, the centre of the nervous system, is protected by the skull and is continuous with the hollow spinal cord. This is enclosed within the vertebrae. The brain and spinal cord resemble a

headquarters telephone exchange, which is constantly receiving information and sending out messages. From the brain twelve pairs of nerves pass to the nose, eyes, face, ears and throat and more than thirty pairs of nerves branch out from the spinal cord to every part of the trunk, arms and legs.

Nerves are made up of bundles of parallel fibres, which divide into smaller and smaller branches. Like telephone wires, they carry messages. Sensory nerves carry messages from sense organs (such as the eyes, ears, nose and skin) to the brain, motor nerves carry messages from the brain to the MUSCLES. If your finger touches a lighted match, your brain will soon know



Plan of the netball pitch

all about it—it will at once send a message to the hand muscles and your finger will be jerked away. The brain and spinal cord have to control not only voluntary muscular movements, but all the processes of the body which must go on whether we are conscious of them or not, such as digesting food and the beating of the heart. Each part of the brain has a special function concerned with memory, speech, movement, breathing, etc. The nervous system links together and co-ordinates all the systems of the body. See SENSES.

NESBIT, E, is the pen-name of Mrs Bland, a children's writer. Several of her best books are about the Bastable family.

NETBALL is a game for two teams of seven players, the winners being the side which scores most goals. The side winning the toss may choose to have first throw, or choose the goal into which they will shoot. The game is started by the centre, standing at the end of the centre line, who passes the ball to another of his team, opposing centres start off the game alternately after each goal is scored. The ball, a leather football, is thrown from player to player in an endeavour to get it into the hands of either attack or shooter inside the circle: these are the only two players who can score a goal, which they do by throwing the ball from inside the circle through a 15-inch iron ring hung with a net open at the bottom, fixed 10 feet high to a post. Players may dodge and run to put themselves into a favourable position to receive the ball. They may not run with the ball or hold it for more



A tense moment in a game of netball

than three seconds, or roll or bounce it, and may only play in certain areas: thus shooter and attack are offside in their own defending court, the three centre players are offside in either shooting circle, while goalkeeper and defence are offside in their team's attacking court. For infringements of the rules, such as offside, a free pass is given to the other team. For rough play, such as taking the ball from an opponent, holding, pushing or obstruction, a free shot is given to the other side. This is taken by shooter or attack from outside the circle, with the defending goalkeeper and all others of his team standing outside too. A game consists of two periods of fifteen minutes each, the teams changing ends at half-time.

This game is particularly popular among girls.

NETHERLANDS, a kingdom of north-west Europe, often called Holland after its two western provinces—North and South Holland. Although small, it has long been a leading country in commerce and shipping. The Netherlands Empire includes part of New Guinea, Dutch GUIANA in South

America and some islands in the WEST INDIES

The western districts of the Netherlands are below sea-level, but great concrete dykes have been built for protection from sea and river flooding, and large areas are being re-claimed from the sea and Zuider Zee. The drained areas or polders, still wet, support cattle, the drier parts are intensively cultivated, especially in the west. Coalmining is carried on in the south-east. The chief commercial city, Amsterdam,

and the second city, Rotterdam, near the mouth of the RHINE, are both great ports. The Government buildings and Royal Palace are at The Hague, the capital of the country. The exports are mainly dairy produce, flowers and bulbs, but weaving, pottery, margarine and chocolate making, shipbuilding and diamond cutting are important industries.

NEW CALEDONIA. See PACIFIC OCEAN

NEWFOUNDLAND is an island which controls part of LABRADOR. In 1948 it decided to join the confederation of Canada. The climate is severe and the soil poor, but the abundant timber and HYDRO-ELECTRIC power make the island one of the world's chief paper producers. Fishing, especially for cod, on the Grand Banks is



Netherlands, a flat, low-lying country

important, and iron ore is mined. The capital is St John's. See map of CANADA

NEW GUINEA. See EAST INDIES
NEWSPAPER, a publication, usually daily, giving current news with some editorial comment and usually a number of special features (see below). The publication of news-sheets or gazettes was common in Europe in the 16th and early 17th centuries. The *Oxford Gazette* (1665) was the first real newspaper to appear in England, later becoming the *London Gazette*, which still survives for official announcements. The first London daily, *The Daily Courant*, appeared in 1702, while 1772 saw the beginning of the *Morning Post*, and 1785 of *The Times*, which took its present name in 1788. Then, too, there developed the forerunners of the

modern weekly papers (like the *Spectator* and *New Statesman*) which set out to give, not news, but interpretation of events—political, social, artistic—seeking to guide public taste See ADDISON The professional status of journalists improved in the 19th century, when newspapers with remarkable editors and well-informed contributors exerted much influence over public opinion Until 1855 newspapers were heavily taxed The tax removed, they quickly increased their circulation, and were thereby able to widen their scope

Thus in the 20th century, home pages, children's features, sports and literary notes, serial and short stories were all included Illustrations, too, became extremely important, and with the increase in kinds of features there was a corresponding change and increase in advertisements See JOURNALISM and PRINTING

NEWT See FROG

NEW TESTAMENT. The twenty-seven books of the New Testament were written first in Greek There are twenty-one letters or epistles, four gospels, one history book (the Acts of the Apostles), and one book called the Revelation which sets forth visions, the meaning of which is not always apparent, but is believed by some to reveal the future if correctly interpreted

When St PAUL spread the word of Christ on his journeys, more groups of Christians or churches grew up The letters St Paul wrote to help them can still be read in the New Testament They were sent by messengers to the Christians at places like Rome, Corinth and Philippi, and sometimes to individuals, such as Philemon Other letters were written by the brothers of Jesus—St James and St Jude—but the writer of the letter to the

Hebrews is unknown Parts of these letters were read when the Christians met for HOLY COMMUNION and prayer

Similar accounts of the life of JESUS were written by Sts MATTHEW, MARK, and LUKE The Gospel of St JOHN was written later, and differs from the others because it contains more long talks of Jesus and deals less with his actions than with his teaching

The "Acts of the Apostles" tells how the Church spread from Jerusalem to Judaea and Samaria, Syria, Asia Minor and to Europe The Church decided at the Council of Jerusalem that Christians need not follow Jewish law The writer, St Luke, also tells most of St Paul's life See BIBLE

NEWTON, Isaac, Sir (1642-1727), was the English mathematician who first stated the laws of gravitation and light He also constructed the first reflection telescope



Newton expounded gravitation

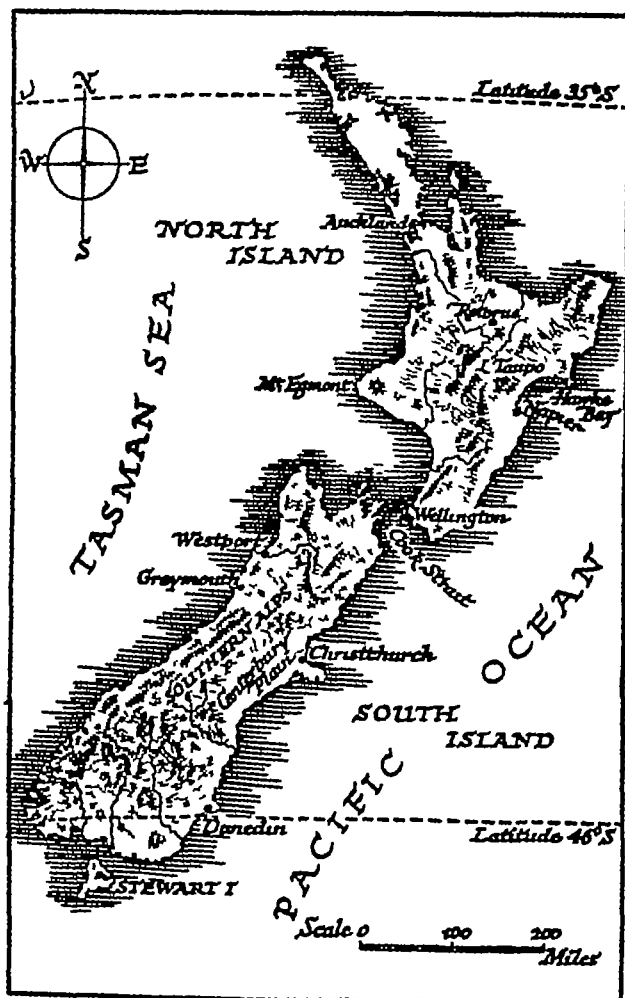
NEW ZEALAND is a member of the British Commonwealth, and comprises North Island, South Island, and the small Stewart Island. Most of the people are of British descent. Many descendants of the original Maoris, who came from the islands of Polynesia, live in North Island, some in the same conditions as their primitive ancestors. Most of them nowadays are farmers. The climate of New Zealand is similar to that of the British Isles, especially in the south, and crops and animals introduced by British settlers have flourished.

South Island. The west is thickly forested and the high rainfall prohibits much farming. Coal is mined round Greymouth and Westport. The Southern Alps are noted for winter sports. Apples are the chief product in the northern valleys. The Canterbury Plains on the drier eastern side are famed for wool and Canterbury lamb. The Otago region in the south is cooler and there are wide moorlands. Oats and dairy produce are the typical products.

North Island. Sheep are reared on the eastern mountains and dairy cattle on the damp lowlands round Mount Egmont, a volcanic cone. There are many VOLCANOES (mostly inactive), GEYSERS and hot SPRINGS in the central region, and the soil is poor. Lemons, oranges and grapes are grown in

the Auckland peninsula. Resin or gum from decayed pine trees is exported. Auckland is the largest city in New Zealand and a great port, but the capital is Wellington, which has a fine harbour. The chief exports are butter, cheese, wool, frozen mutton, and beef, most of which are sent to the British Isles in return for manufactured goods.

History. New Zealand was discovered by the Dutch navigator, Abel Tasman, in 1642, and named after Zealand, one of the Dutch provinces. The islands were visited and explored by Captain Cook in



New Zealand, fertile farming country

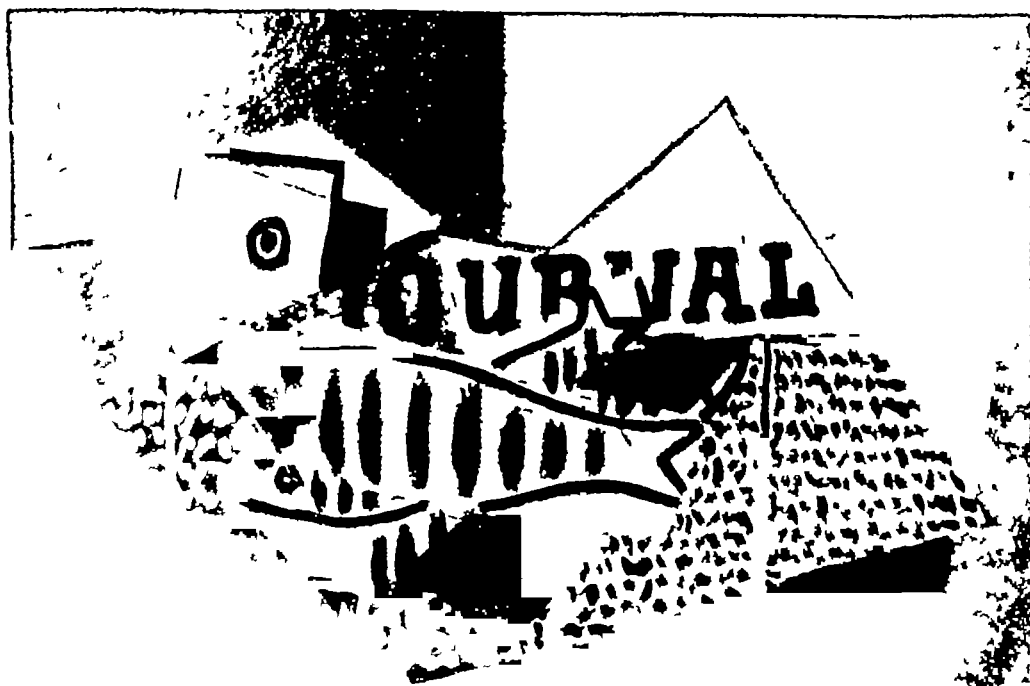


Paintings in different styles above is "Salisbury Cathedral," by the landscape painter, Constable (reproduced by permission of the National Gallery, London), below, a picture full of detail, Millais's "The Blind Girl" (by permission of the Birmingham Museum and Art Gallery), is compared with Manet's bold and simple "Boy Fifer" (by permission of Établissements Braun et Cie) See OIL-PAINTING





Above is Breughel's "Peasants Dancing in a Village Street" (copyright of the Medici Society, London) it is a 16th-century painting of Flemish villagers enjoying themselves and is in sharp contrast to the modern still-life study by Picasso below, a design made up of dead fishes on a newspaper (reproduced by permission of Edward Wadsworth, Esq , and the Soho Publishing Company Ltd) See OIL-PAINTING



1769, and again in 1773, 1774 and 1777. From 1792 the crews of sealing and whaling vessels had settlements along the coasts, and trade in timber and flax followed. Christian missionaries arrived in 1814.

In 1833 a British Resident was appointed. A thousand British colonists arrived in 1839, and on hearing that the French were about to send out a similar expedition, the Government of New South Wales took formal possession in the name of Queen Victoria. New Zealand became a separate colony the following year.

In 1840 Captain Hobson met the Maori chiefs at Waitanga, and made a treaty with them, but there was much fighting between them and the white man for many years. The man who did the most to win the trust and respect

of the Maoris was Sir George Grey, who was governor from 1845 to 1853, and again from 1861 to 1867. During his last term of office, he brought the Maori wars to an end.

In 1907 New Zealand became a self-governing dominion, and the Maoris have a share in the government. During both World Wars New Zealanders have fought in defence of the British Commonwealth.

NICARAGUA is a small republic of Central America. The capital is Managua. Its products include coffee, bananas and gold, and many cattle are bred. See map of CENTRAL AMERICA.

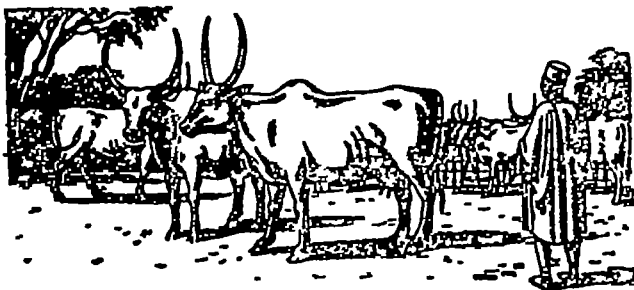
NICHOLAS, St., the patron saint of children. Some say he was a bishop at Myra in A.D. 300. The

name "Santa Claus" is derived from his name.

NICKEL is a metallic ELEMENT which somewhat resembles iron. It is made into many ALLOYS, particularly for electrical purposes. Nickel plating of other metals is widely used owing to its resistance to corrosion.

NICKEL-SILVER is an ALLOY of nickel, copper and zinc, and is largely used for cutlery, often being plated with silver.

NIGERIA is a West African British Crown colony of forest and savannah, producing palm oil, mahogany, cocoa, ground nuts and cereals in the savannah region,



Breeding cattle in Nigeria

where cattle are also reared. Some tin and coal are mined. Lagos, the capital and chief port, is linked by rail to Kano, the main inland town. See the map of AFRICA.

NIGHTINGALE, Florence (1820-1910), pioneer of the nursing service. See CRIMEAN WAR.

NILE, one of the longest rivers in the world. It starts as two rivers, one of which, the Blue Nile, rises in the mountains of ABYSSINIA, and the other, the White Nile, in the UGANDA highlands among the great lakes. In EGYPT its annual floods make a fertile stretch in which three crops a year may be grown. It ends in the Mediterranean in a DELTA, near the mouth of which stands Cairo. It was the centre of ancient

Egyptian civilization, and many ruins still stand along its banks See maps of AFRICA and EGYPT

NITRATES are compounds of nitric acid with other substances, and are widely used as fertilizers and sources of oxygen for explosives Common nitrates are sodium nitrate or Chile saltpetre, potassium nitrate or normal saltpetre, ammonium nitrate, cellulose nitrate for films and explosives. Chile is one of the world's chief sources of nitrates

NITRIC ACID is a fuming and strongly corrosive liquid, colourless when pure but turning yellow in the light It can be prepared by the action of strong sulphuric acid on saltpetre It is now extensively prepared by the controlled oxidation of ammonia It is a strong oxidizing agent and widely used in the laboratory and in industry

NOCTURNE, a "night-piece," is a name in music given to certain quiet pieces such as the nocturnes of CHOPIN

NOMADS are people who move from place to place in search of water and pasture for their flocks and herds They live in the STEPPE, semi-DÉSERT and TUNDRA regions Their homes are generally tents, which can be easily transported Eskimos are semi-nomadic, as they often settle for a time in one place, but the desert Bedouins and the Tartars of the Asiatic steppes are more truly nomadic

NONCONFORMIST is a Protestant who does not conform to or accept the teaching of the Church of England Among the Free Churches are the CONGREGATIONALISTS, BAPTISTS, METHODISTS, and the SOCIETY OF FRIENDS or Quakers

NORTH AFRICA is largely desert land with a narrow coastal strip sparsely settled, except in EGYPT and the western coastlands

The Atlas Mountains belong physically to the mountain system of southern Europe Around them is the only area which has much rainfall, but the east is drained by the NILE The population is mostly of Arabic or mixed Arabic and Negro descent, with a comparatively large number of white settlers Inland the people are mostly nomadic Berbers

See also ALGERIA, LIBYA, MOROCCO, TUNISIA, and the map of AFRICA

NORTH AMERICA is a continent including ALASKA, CANADA, NEWFOUNDLAND, the UNITED STATES and MEXICO. Physically it consists of the Rocky Mountain system in the west, the smaller Appalachian ranges in the east and the Canadian Shield of old, hard rocks in the north-east, between which are the great plains drained by the Mackenzie, St Lawrence and Mississippi-Missouri river systems The St. Lawrence River drains the five Great Lakes, which, except for Lake Michigan, form part of the boundary between Canada and the United States Before the coming of white men, North America was the home of the Red Indian hunters and fishermen As white settlement spread, the wide spaces where the Indians used to hunt were taken over, and although Indian Reservations have now been set aside by the Governments in Canada and the United States where they may follow their own way of life, pure Indians are gradually dying out

NORTHERN IRELAND is the north-eastern part of the island of IRELAND and politically part of the UNITED KINGDOM Agriculture supports about half the people oats, flax and potatoes are grown, and cattle, pigs and poultry reared Londonderry, and the shipbuilding centre of Belfast, also centre of the linen industry and the capital of

the country, are the chief towns
See map of IRELAND

NORTHERN RHODESIA is a British Crown Colony in Africa. It is a high plateau rising towards the great lakes in the east. The climate is tropical. The small white population grows maize and tobacco. There are large native-owned herds of cattle. Copper, cobalt, vanadium and zinc are mined. The capital is Lusaka. See map of AFRICA.

NORTH SEA, a shallow arm of the Atlantic lying on the continental shelf of north-west Europe. It contains some of the richest fishing grounds. See map of EUROPE.

NORWAY is a narrow, mountainous north European kingdom with a coastline broken up by FJORDS. More than half the country is high mountain or upland pasture, and there are extensive forests on the mountain slopes. Only a small part is cultivated, and many of the people are fishermen or farmers. Paper-making and fish-canning are the chief industries. The main exports are fish, paper, wood-pulp and minerals. The chief towns, Oslo (the capital), Bergen, Stavanger, and Trondheim, are also fishing ports. Norway is part of SCANDINAVIA, of which a map is given.

NOTATION, MUSICAL, is the scheme of symbols to indicate musical sounds and pauses. Two methods are in common use today: (1) staff notation, and (2) tonic sol-fa notation. A five-line stave, with various CLEFS which fix the



Tonic Sol-fa

| d d r | t . - d . r |

Two kinds of musical notation

position of one note (e.g. G or treble clef, F or bass clef) gives a picture of the rise and fall of the melody, and symbols have been













Notes		Rests
	= 1 SEMI-BREVE	
	= 2 MINIMS	
	= 4 CROTCHETS	 r or /
	= 8 QUAVERS	
	= 16 SEMI-QUAVERS	
	= 32 DEMI SEMI-QUAVERS	

Table to show what the notes and their rests look like, and how many of each equal a semi-breve

evolved to show the relative lengths of the sounds. The tonic sol-fa system, using, to denote relative pitch, syllables adapted from a Latin hymn, has its own method of showing the duration of the notes, it is essentially a notation for singers.

NOUN See GRAMMAR

NOVEL See FICTION and DEFOE

NUN, a woman living in a convent who, like a MONK, is a member of a religious society. Becoming a nun is called "taking the veil."

NYASALAND is a small British protectorate lying west of Lake Nyasa, Africa. Few cattle can be reared because of the tsetse fly, but tobacco, cotton, coffee and tea are exported through Beira in MOZAMBIQUE.

NYMPHS, in CLASSICAL MYTHOLOGY, are lesser deities believed by the GREEKS to inhabit springs, rivers, trees, mountains—nereids, naiads, dryads, etc.



OASIS, a fertile spot in the desert due to the presence of water there Rain-water collects under the sand where the lower soil is non-porous, it may come to the surface or need a well to reach it

OBJECT (in grammar) See GRAMMAR

OBOE See REED INSTRUMENTS

OCEAN CURRENTS (drifts) are caused chiefly by the prevailing winds which tend to blow the surface waters before them Currents moving towards the equator are cold, and those moving away from it are warm The currents affect the temperature of the air above them and of the coastlands along which they flow, but this influence does not penetrate far inland The North Atlantic Drift has a modifying effect on the climate of the British Isles Fogs are common off NEW-ROUNDLAND where the cold Labrador current meets the warm GULF STREAM The seasonal change of direction in the Indian Ocean is

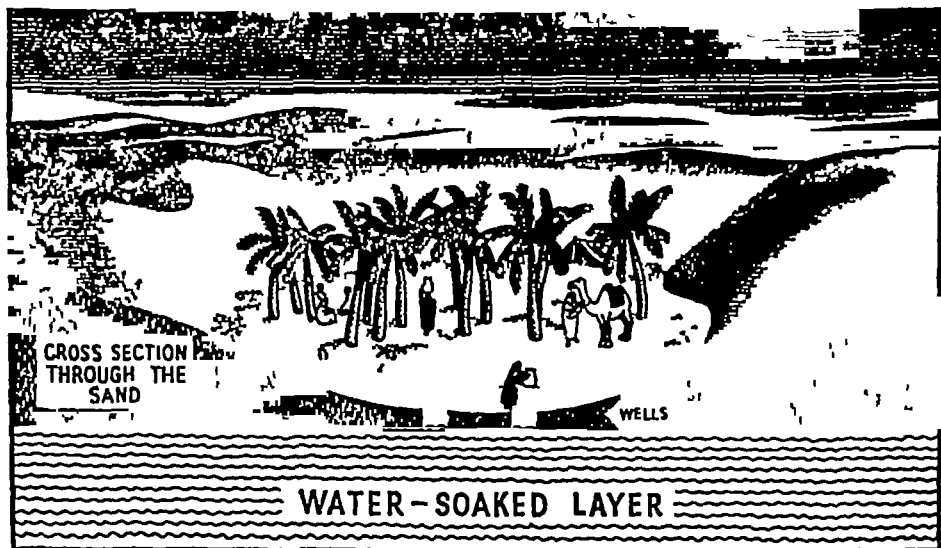
due to the monsoon wind reversal. In general, warm currents temper the climate of the coasts they wash, and cold currents cause onshore winds to drop their moisture before reaching land See CLIMATE

OCTAVE, a musical INTERVAL of eight notes, giving the same note but at different PITCHES It is also a SCALE of eight notes

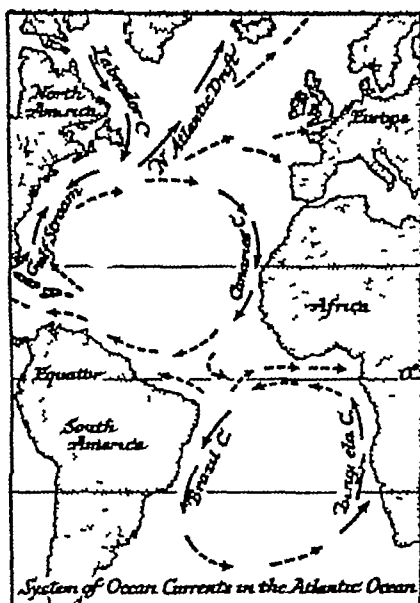
OCTOPUS. See MOLLUSC

ODYSSEUS is the hero of Homer's *Odyssey* King of Ithaca, he accompanied the Greeks to Troy and on the return voyage had many adventures which are the subject of the *Odyssey* He was noted for his craft and eloquence, according to CLASSICAL MYTHOLOGY

OHM is the unit of electrical resistance It is defined as the resistance of a certain length of mercury thread Ohm's Law states that at a constant temperature the voltage across any conductor is proportional to the current passing through it, and the resistance of a



In this oasis wells have been sunk down to the water-soaked layer



Winds cause ocean currents

conductor is the voltage divided by the current See ELECTRICAL ENERGY UNITS

OIL-PAINTING, as we know it today, was used by the Van Eycks and by other northern painters, such as Albert Durer, the German artist, but the Venetian painters were responsible for bringing it into general use from the 16th century onwards

At first oil-paint was only used as a thin glaze over a ground work of tempera (See PAINTING) Titian and his followers painted pictures first in monochrome (that is one colour, usually brown or green), and then painted their glorious colour over it all in oil-paint Rubens, Rembrandt, and the Spaniard Velasquez used oil-colour from the beginning and worked up their pictures in brush strokes of full colour

The brushes used for oil-painting—which is a heavier medium than water-colour or tempera—are usually of hog's hair, though sables

are also used for finer work Oil-colours ready for use are sold in tubes today, and only require to be mixed with a little oil—linseed or poppy oil are the most common

One advantage of oil over water-colour painting is the possibility of making alterations either when the painting is still wet or after it has become quite dry The paint can be put on in broad or fine strokes, in little or larger spots of colour side by side, as was done by the French painter Seurat, or in lines of different colour as used by the Dutch painter Van Gogh See IMPRESSIONISM For the names of other great artists, see ART, LANDSCAPE PAINTING and STILL LIFE

OLD TESTAMENT, a collection of thirty-nine books of different kinds originally written in Hebrew—law books, history books, poetry books, books of prophecy and a song book—all relating to the Jewish people, and, in the Christian belief, unfolding to Man the knowledge of God and His plan for the



Van Gogh, Dutch painter

world The first book to be written down was probably that of Amos, about 750 B C

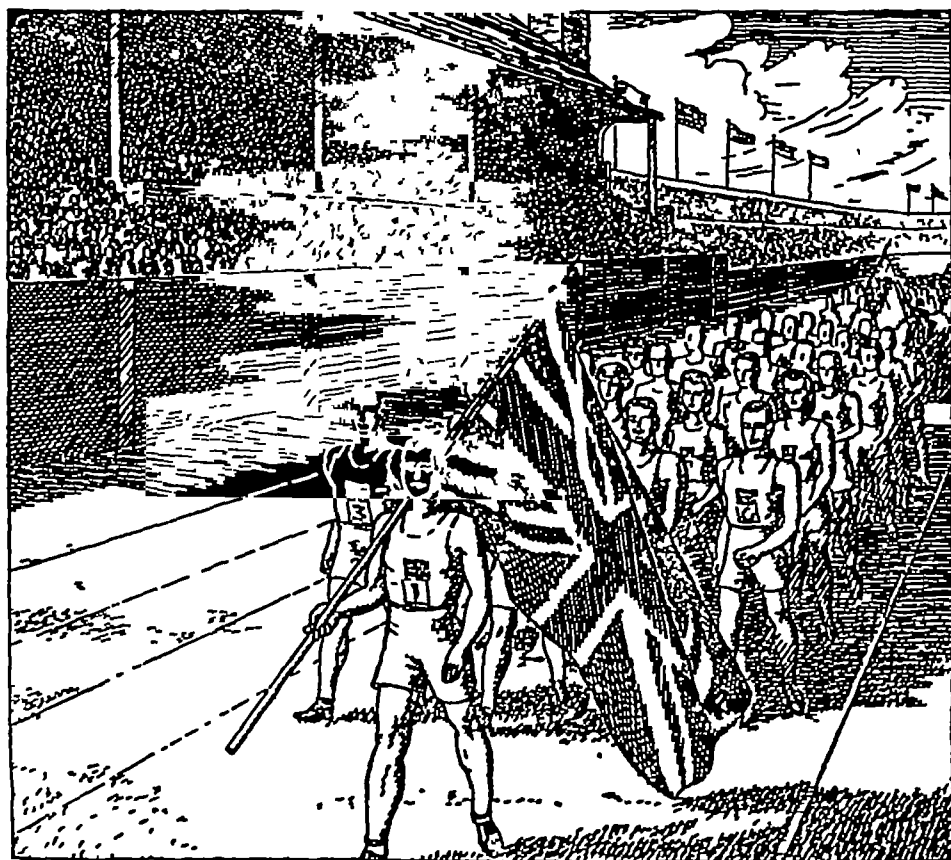
After the first stories of myth and legend, the history begins with Abraham, the work of MOSES, and the COVENANT that JEHOVAH made with the Israelites We learn that after Canaan had been partly taken, kings were chosen—Saul, David and Solomon in turn, and then the people separated into two kingdoms—Israel in the north, and Judah in the south Then the great prophets came, like Amos and Isaiah, who taught that God was holy, and that His people must not serve false gods but worship Jehovah with all their heart, or they would suffer But the people did not listen and were eventually conquered, the North Kingdom

first, later the people in the South Kingdom who were carried away to EXILE, about 600 B C Fifty years later they returned and rebuilt Jerusalem and the Temple, but they had many difficulties The Greeks conquered them about 300 B C and the Romans in 63 B C The Jews grew to think that the keeping of the law was most important, and in their troubles looked for the coming of a mighty prince, called the MESSIAH, whom God would send to deliver them

See BIBLE

OLYMPIA is a plain in Greece where the OLYMPIC GAMES were held every four years in the days of the Ancient GREEKS

OLYMPIC GAMES were originally the national festival of the Ancient GREEKS, held every four



Parade of the athletes at the opening of the Olympic Games

years in honour of the god Zeus. The festival consisted of music, drama, art, etc., as well as athletics. Of the latter there were wrestling, boxing, racing on foot and on horse, chariot races, throwing the discus, races of men clad in heavy armour and so on.

The Olympic Games today are a revival of this festival, but they are confined to athletics and are an international affair, held every four years in different countries. The events for men and women include running, jumping, discus throwing, hurdles, swimming, and walking, besides organized games.

The games were revived at Athens in 1896, and have been held in Paris (1900), St. Louis, U.S.A. (1904), London (1908), Stockholm (1912), Antwerp (1920), Paris (1924), Amsterdam (1928), Los Angeles (1932), Berlin (1936), and in London (1948).

OLYMPUS is, in **CLASSICAL MYTHOLOGY**, a mountain in northern Greece, home of the gods.

OMAN See **ARABIA**.

OMAR KHAYYAM, **THE RUBAIYAT OF**, is a series of epigrams written by the 11th-century Persian mathematician and astronomer, Omar Khayyam. They have been translated into many modern languages. A famous free English translation is by Edward Fitzgerald, which first appeared in 1879.

ONOMATOPOEIA. See **IMAGERY**.

OPERA is drama set to music. In grand opera, every word is sung. At first it was a highly conventional form of art, in the early Italian opera, only classical stories were thought fit for setting, the singers had each to be given opportunities for displaying their vocal ability, the overture had little or no connexion with what followed, and

the music had little bearing on the words. The first composer to fight against these conventions was Gluck (1714-1787). His reforms and those of Weber (1786-1826) prepared the way for **WAGNER** (1813-1883), whose mighty music dramas still remain the highest point of operatic development. Opera has always been popular in Italy, and there have been many famous Italian composers, including Rossini, Donizetti, Bellini, Verdi, Mascagni, Leoncavallo and Puccini. France has given us Ambroise Thomas, Gounod, **BIZET**, Saint-Saëns, Massenet, and Charpentier. In Britain opera has never captured the public fancy, although certain works, such as Balfe's *Bohemian Girl* and Wallace's *Maritana*, had at one time a great vogue, and more modern composers, like Charles Stanford, Vaughan Williams, Benjamin Britten and William Walton have written fine operas. British tastes run more in the direction of light opera, such as *The Beggar's Opera*, produced by Gay and Pepusch in 1728 as a protest against the fashion of the conventional Italian operas. In it, songs and concerted numbers are interspersed with the spoken dialogue, and so it is a direct forerunner of the comic opera of later times. This type of opera (known in France as *opéra comique*, and in Germany as *Singspiel*) is at its best in the works of **GILBERT AND SULLIVAN**, with its combination of well-constructed libretto and masterly light music. This has, in turn, given rise to musical comedy.

OPOSSUM See **POUCHED MAMMALS**.

ORACLE. In ancient Greece an oracle was the place where a god spoke through a priest. The "divine guidance" thus given—usually in answer to questions—was often a

riddle capable of more than one interpretation The most famous oracle was the Temple of Apollo at DELPHI

ORANGEMEN are members of a Protestant society formed in Ulster in 1795 The name was taken from the Protestant WILLIAM III (Prince of Orange) who defeated the deposed Roman Catholic king, JAMES II, in the Battle of the Boyne (1690)

ORANG UTAN. See APE

ORATORIO is the setting to music of a religious theme It is performed by soloists, chorus and orchestra, usually without stage scenery or actions

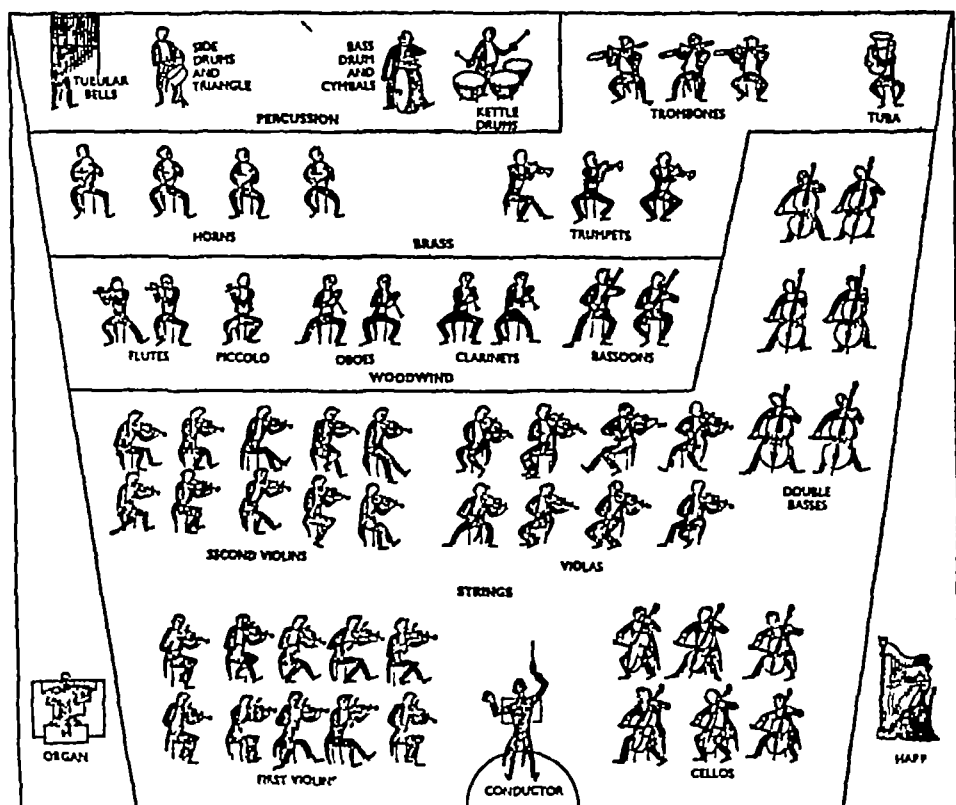
ORCHESTRA is the collective name for the instrumentalists used either to accompany an OPERA, ORATORIO, CHOIR, or stage show, or independently for the performing

of pieces written solely for the orchestra, such as a SYMPHONY, or for orchestra and soloist, such as a Concerto

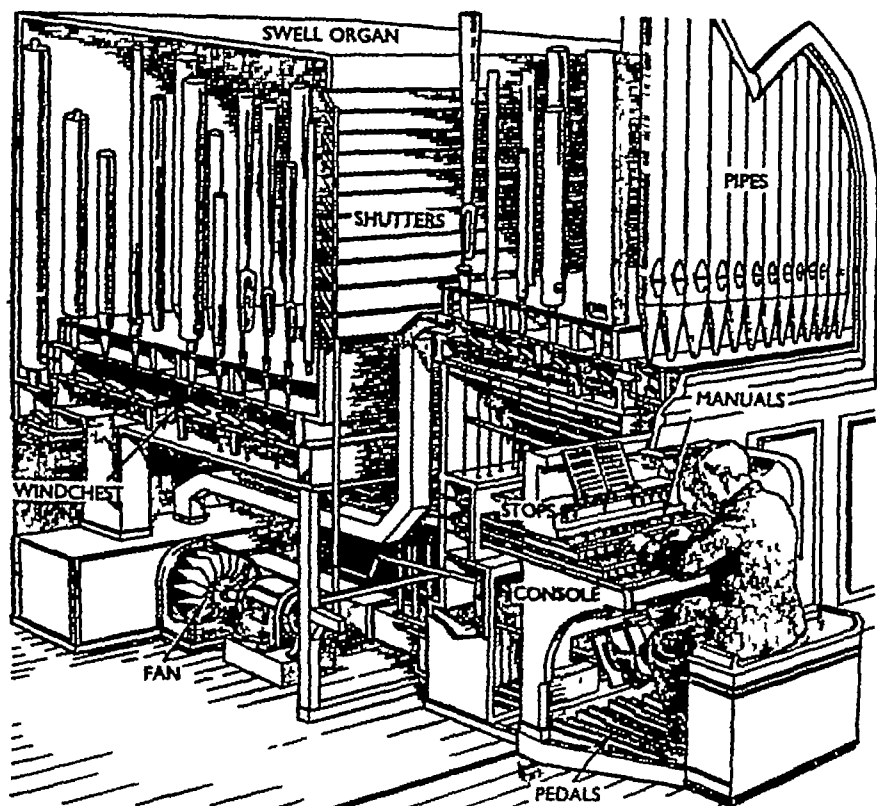
The illustration shows the disposition of the players in a symphony orchestra, which is divided into the following main classes of instruments STRINGS, WOODWIND, BRASS, and PERCUSSION The harp and ORGAN are also sometimes added Detailed pictures of the instruments are shown on pages 404-405

ORE is a mineral or rock which contains sufficient percentage of a metal to make it worth while extracting the metal

ORGAN. Scots people used to call this great instrument "a kist (chest) of whistles," and with some justification, as it is an instrument, the notes of which are produced



Typical arrangement of the instruments in the orchestra



In the organ, wind is released into a pipe by depressing a key or pedal

by sets of whistles or pipes, each set having some special tone quality. The wind for the pipes, supplied by bellows or an electric fan, fills the windchests, from which air is admitted to a pipe on the depression of a key or pedal by the player sitting at the console. Each set of pipes is controlled by a stop. One whole section of stops is devoted to sets of pipes enclosed in a case fitted with a Venetian blind, which opens or closes at the will of the player, as the shutters of the blind open, so the music swells out, and this is therefore known as the swell organ. The console has several keyboards for the hands (manuals), and a keyboard for the feet (pedals). The tone of the organ ranges from very soft to very loud,

and the various stops give a marvellous variety of musical sound. Organs are found in cathedrals and churches, in concert halls, and in recent times in cinemas.

ORGAN, AMERICAN. See HARMONIUM

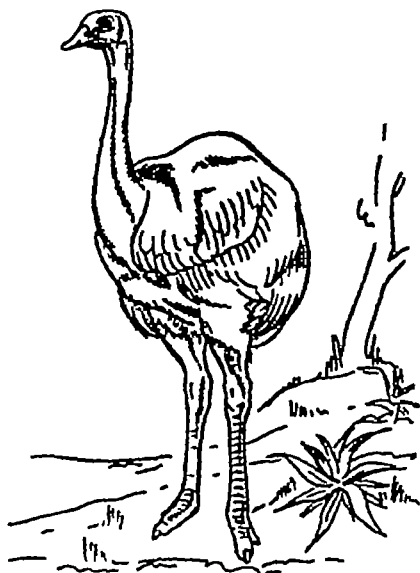
ORGANIC COMPOUNDS, originally the name given to compounds formed in living things and supposed to be built up by such organisms. Now the term is applied to the endless number of compounds formed by the combination of carbon (the chief constituent of living matter) with hydrogen, oxygen, nitrogen, and other elements. Most of these can now be built up by the chemist in the laboratory. Examples are ALCOHOL, HYDROCARBONS, FATS, PROTEINS. See SOIL

ORIENT, lands east of Europe
ORION, in **CLASSICAL MYTHOLOGY**, is a mighty hunter who on his death was placed among the stars, he is recognized by his girdle, sword, and club

ORPHEUS, in **CLASSICAL MYTHOLOGY**, is the most famous Greek musician and hero Taught by the Muses he played so skilfully on the lyre that wild animals were tamed and trees and stones moved to hear him When his wife Eurydice died he went down to Hades, and so charmed **PLUTO** with his music that Eurydice was allowed to accompany him to the upper world on condition that Orpheus did not look round until he regained the upper world again He broke the condition only to see his wife snatched away back into the nether regions

OSCILLATION. A body or point is said to oscillate if it moves backwards and forwards over the same path, like the bob of a **PENDULUM**

OSTRICH, the largest bird, stands eight feet high, and lays enormous eggs. It cannot fly, and



Ostrich, a bird that cannot fly

has only the remains of wings but runs very fast In South Africa ostrich farms produce and export its great plumes The related Australian emu and cassowary are smaller.

OTTER, a **FLESH-EATING MAMMAL**, adapted for a water life by short legs with webbed toes, thick,



Otter all ready for his meal

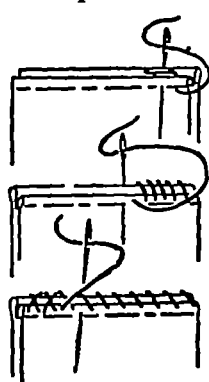
close fur, and a flattened rudder-like tail British otters swim and play in rivers, the long, slim bodies twisting and turning as they chase fish under water. By day they sleep in holes tunnelled in river banks, whistling as they emerge at dusk to catch fish, frogs and other animals Otters also range sea coasts for fish and crabs Sea otters are a different species

OUTCROP. A stratum or layer of rock which is not parallel to the earth's surface may come to the surface at a certain place It is then known as an outcrop

OVERDRAFT, money which a **BANK** may in certain circumstances allow you to draw after you have withdrawn all the money you had

deposited with it If, for example, you have deposited £100 and you write cheques to the value of £110 and the bank decides to honour them, then the bank has allowed you an overdraft of £10 This is a bank loan On this overdraft, the bank will charge you interest

OVERSEWING is used to secure SEAMS in the joining of materials, the sides of bags, sewing on straps, and so on First crease a fold along both pieces of material, and tack



Oversewing

them together wrong side to wrong side as in the top sketch Insert the needle at the right side in the position shown in the middle sketch, and let the end of the cotton rest between the layers of the material, securing it between stitches as they are made When making the stitch, have the needle at right-angles to the edges Fasten off by working backwards for three stitches as shown in the bottom sketch

OVERTURE means literally "an opening" The word is used for the prelude to an OPERA or ORATORIO or stage play It is also an independent piece of orchestral music of a descriptive nature

OWL. Tawny, barn and other owls, which are often heard hooting or giving their hunting cries at night, nest in hollow trees and barns They catch mice, helped in the dim light by their keen vision and silent wings The fur and bones of their prey are ejected through the beak as pellets Pictures on page 76

OX. See TRANSPORT

OXALIC ACID is a poisonous ORGANIC acid found in the roots of ordinary rhubarb It is used for removing ink stains and in photography

OXIDES are compounds of any element with oxygen Oxides of non-metals usually form acids if dissolved in water Metal oxides are usually basic and form ALKALIS if they dissolve in water, combined with acids they form SALTS Peroxides are a type of oxide containing a higher proportion of oxygen than the normal oxide of this element

OXY-ACETYLENE FLAME, an intensely hot flame (over 4,000 deg C) caused by burning together the gases oxygen and acetylene in a special torch

The flame is used for welding or cutting metals

OXYGEN is a gaseous ELEMENT which composes one-fifth of our atmosphere It is essential for breathing and for combustion or burning It was discovered by Priestley and Scheele at the end of the 18th century It is prepared in the laboratory by heating potassium chlorate with a little manganese dioxide, and in industry by the distillation of LIQUID AIR Stored in containers it is used by airmen and climbers to overcome the scarcity of oxygen in the air at high altitudes, and in hospitals it is given to patients with lung trouble It is also used by firemen when entering a smoke-filled building, and by men escaping from a submarine

See BREATHING APPARATUS and OXIDES

OZONE is a form of OXYGEN in which there are three atoms in the MOLECULE, instead of two The gas is formed by the action of a silent electric discharge or lightning on air, and is commonly found in the atmosphere over the sea



PACIFIC OCEAN, the world's largest stretch of water, is ringed by a volcanic girdle of mountains, and the ocean floor is marked by submarine ridges which appear at the surface as island festoons. The greatest depth measured is $6\frac{1}{2}$ miles, east of the Philippines. Many of its islands are volcanic, others are of CORAL. The coco-nut palm is widespread and yams and sweet potatoes are the chief foods on these islands, most of which have a warm climate. Honolulu is a great tourist centre in Hawaii. The white settlers are usually officials, traders, planters and missionaries. The natives are mainly Polynesians.

Hawaii (U S A territory) specializes in sugar and pineapples, Fiji (British) in sugar, rice and coco-nuts, New Caledonia (French) in chrome and nickel. Part of Samoa is controlled by New Zealand. The United States rule the rest of this and other islands scattered throughout the North Pacific. The Solomon Islands are partly British, the rest are under Australian mandate.

The Philippines lie very close to the East Indies. Luzon in the north and Mindanao in the south are the two main islands, with thousands of small islands between. Much of the land is densely forested jungle, from which bamboo and other timber is produced, other important exports are sugar, rice, coco-nuts and copra, manila hemp, and tobacco. See map of the WORLD.

PAINT is material used to protect or decorate surfaces. It has three essential components, a body material such as white lead, a binding oil such as linseed oil, and a "thinner" such as turpentine. To

these are usually added pigments or colours for decorative effect, and "driers"—substances which speed up the hardening of the oil. The body material is suspended in the oil and the "thinner" helps in spreading it uniformly over the surface. The "thinner" then evaporates and the oil, under the influence of the air, hardens to a tough elastic skin, which together with the lead protects the surface beneath from rotting.

PAINTING, in art, is the application of colour to canvas, paper, wood, plaster, etc., so as to make a picture or decoration.

There are very few masterpieces of painting surviving from the far-off ages, but we know that people painted on walls and on statuary (to make it more lifelike), as well as for decoration on articles of use. The GREEKS, for example, decorated their vases and jars with SILHOUETTE paintings of everyday activities.



Constable, landscape painter

Painting as we know it today, however, began in Italy in the 13th and 14th centuries OIL-PAINTING and WATER-COLOUR PAINTING came much later The earlier Italians used a paste of coloured powders mixed with yolk of egg and gum, and painted this on wooden panels covered with a thin layer of plaster mixed with glue (called gesso) This method was called tempera painting When they painted their pictures on to the panels before the plaster was dry, the colour became part of the plaster This is called fresco (or wet) painting When it was done on the plaster after it had dried hard it was known as secco (or dry)

Many Italian painters experimented with gums and resins and oils, but oil-painting as we now know it began in Flanders with the two great Flemish painters, Hubert and Jan Van Eyck The Venetian painters, Giorgione, Tintoretto and Veronese, developed the art of oil-painting, and the freedom given by the new medium is to be seen in the easy movement and roundness of the figures in their great masterpieces

Today the artist buys his paints in tubes or pans or cakes, and his distemper or tempera colour in jars of ready-mixed colours

Methods of putting on colour are many and varied See OIL-PAINTING and WATER-COLOUR Some of the greatest painters known to us, besides those already mentioned, are Giotto, Michelangelo, Raphael, Rubens, Rembrandt, Velasquez, Van Dyck, Vermeer, Poussin, Claude, Holbein, Reynolds, Gainsborough, Millais, Constable, Turner, Corot, Manet, Cezanne, Van Gogh, Gauguin, Picasso, Whistler, Sargent, Orpen and Augustus John See ART, LANDSCAPE PAINTING, STILL LIFE and BAROQUE



Velasquez, Spanish artist

PAKISTAN, those parts of the former **INDIA** which have formed a separate dominion under Moslem control

PALESTINE is territory at the eastern end of the Mediterranean Oranges, grapefruit and other fruit, tobacco and cereals and vegetables are grown in the coastal areas, and olives farther inland The chief towns are Jerusalem and the ports of Haifa, Jaffa, Gaza, Acre and Tel Aviv The population is Arab and Jewish, many Jews have entered Palestine from the distressed countries of Europe of recent years Ruled by Britain under **MANDATE** since 1923, its partition between Jews and Arabs was decided on by the **UNITED NATIONS ORGANISATION** When Britain gave up the mandate in 1948, war broke out between the new Jewish state, Israel, and the neighbouring Arab states See map of **NEAR EAST**

PALESTRINA, Giovanni Pierluigi da (born in Palestrina, from which he took his name, 1525 or 1526, died at Rome, 1594), is one of the greatest composers of polyphonic music His works include masses and madrigals

PALM OIL is obtained from the fleshy fruit of a West African palm. It is used extensively for soap manufacture, and when hydrogenated for edible fats.

PAMPAS is the name for vast treeless plains of South American cattle-rearing pasture land, characteristic of southern **BRAZIL** and **ARGENTINA**. Comparable land in North America is called the prairie, and in south-eastern USA and elsewhere, savannah. Contrast with **TUNDRA** and **STEPPE**s.

PANAMA is a small republic of CENTRAL AMERICA. The capital is Panama City. Through it runs the **PANAMA CANAL**.

PANAMA CANAL runs through the republic of PANAMA from the city of Panama to Colon. It provides a short sea route from the Atlantic to the Pacific. Its construction was begun in 1881 and it was completed by the United States between 1904 and 1914—they control the canal and a five-mile strip of land on either side. It is about fifty miles long, and at one point rises 85 feet above sea-level.

PANDA. Both the giant and little panda, or cat-bear, live in bamboo



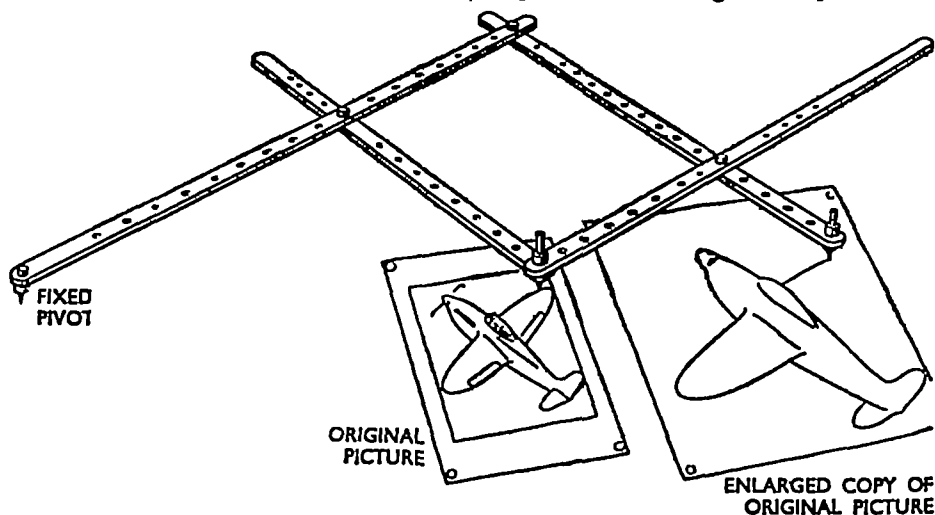
Giant panda of Asia

forests in Asia. Though closely related to the FLESH-EATING MAMMALS, pandas are chiefly vegetarian. The giant panda has white fur with black legs, ears, rings round the eyes and shoulder band. The cubs are very playful.

PANDORA, in CLASSICAL MYTHOLOGY, is the first woman on the earth, endowed by the gods with many gifts. Her curiosity overcame her and she opened a box which contained every human ill to afflict mankind.

PANPIPES, an ancient wind instrument consisting of a set of wooden whistles of varying length capable of producing different notes.

PANTOGRAPH, an instrument composed of stiff rods which enables an enlarged or reduced copy of a drawing to be produced.



The pantograph can make a reduced drawing as well as an enlarged one

PAPER is a material composed of cellulose fibres felted together by the action of water, the resulting fabric being filled with clay and similar substances, and for writing purposes highly compressed and sized to give a non-absorbent surface. The best cellulose is obtained from rags and linen, but the bulk of paper today is made from chemically treated wood fibre obtained by cutting logs into chips and removing non-cellulose parts of the wood by boiling with calcium bisulphate.

Blotting paper is mostly unsized cellulose and therefore absorbent.

PAPIER MÂCHÉ is a modelling material made from mashed and wetted paper or similar material, and treated with paste so that it sets to a hard mass on drying. It can then be varnished and painted. Shop window models and "unbreakable" toys are often made of it.

Papier mâché craft is the making of bowls or trays with newspaper and paste.

You will need a bowl on which to model a new one, plenty of newspaper, flour and water paste, vaseline, size, and enamel. Choose a wide-brimmed bowl which has a smooth outside and which gets smaller towards the base. If it has a bulge which sticks out farther than the rim it will be impossible to remove the model when finished.

Prepare the newspaper by tearing into long strips, to do this, place a ruler on the paper and tear against its edge. Each strip should be about 1 inch wide. Tear these again every 2 inches and then tear from corner to corner. Do not cut the paper, as ragged edges stick together better. Vaseline the bowl all over outside. Starting at the base place small triangular pieces of newspaper on the vaselined surface in

a circle. Each triangle should overlap the next one to it for about $\frac{1}{4}$ inch. Paste these pieces to each other but *not to the bowl*. The vaseline is to prevent the paper sticking so do not rub it off while working.

Cover the whole of the bowl, each piece overlapping its neighbour. The paper edge can be left higher than the rim of the china bowl as it is trimmed off when the paper bowl is removed. The second layer of newspaper should not be put on until the first is dry. Seven or eight layers are essential, and more may be required. After the first layer, the paste is put on to the row below, and the paper well pressed down. No air bubbles must be allowed to form.

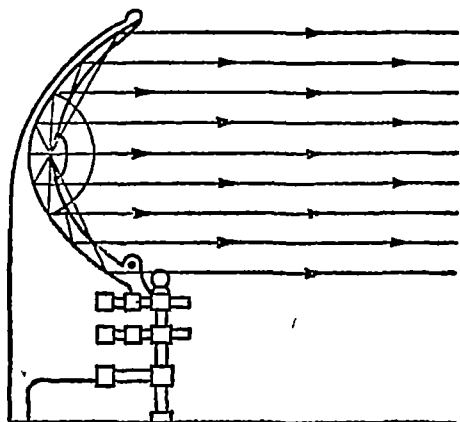
When seven layers or so have been put on, leave it until the paper bowl is very dry and feels firm. Then it can be removed. To do so, run a penknife round the rim between the paper and the china bowl. Loosen carefully, and then lift the paper bowl off. It should come off fairly easily. When it is off, trim the top edge, and put another layer of paper inside to cover up the vaselined surface and to make the rim smooth and even. When this is dry, paint the bowl all over with size, using a teaspoonful to a cup of boiling water. Later paint the bowl with a bright enamel paint. You can use one colour for the inside and another for the outside, or decorate it with a border or a pattern. When the enamel is dry the bowl can be used for bulbs if the bulb fibre is not too damp, or for holding pins, buttons, etc.

Small trays are made in the same way by using a strong cardboard box lid as a foundation. In that case the paper can be stuck on to both sides as it will not be removed afterwards. The tray is finished in

exactly the same way as the bowl

PARABLE, an ALLEGORY with a spiritual meaning Jesus taught partly by telling parables, such as those of the Prodigal Son and the Good Samaritan

PARABOLIC MIRROR, a reflecting surface of such a shape



Parabolic mirror of electric fire

that all light or heat falling on it from a lamp or hot point placed at a certain spot is sent out in a parallel beam Such mirrors are used in lamps on cars, in search-lights, and for electric heaters

PARACHUTE, an umbrella-shaped piece of very strong silk, cotton cloth, or nylon, which is used to ensure the slow and safe descent of persons or goods from a great height It is carried folded by airmen for use in an emergency Parachute troops use it to drop from their plane to their assembly point on the ground Ammunition and supplies are also dropped in this way

The packed parachute does not open until its rip-cord is pulled, which allows the air to catch it and pull it out The parachute tends to resist the force of gravity just like an umbrella in a strong wind When the ground is safely reached, the airman operates a catch which

releases him from the parachute harness, thus preventing his being dragged along the ground if there is a high wind

PARADOX See IMAGERY

PARAFFIN GAS COOKING STOVE. The fuel is contained in a strong brass vessel or tank which is provided with an air-compressing pump The fuel is forced up the centre tube into the burner which has first been heated by methylated spirit In the burner the fuel is turned to a gas This escapes at high speed through a very small nipple, burns and heats a pan or other utensil placed over the flame

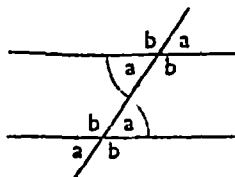
PARAGRAPH. See SYNTAX

PARAGUAY is an inland South American state, much of which is swamp or desert Cereals, sugar, oranges, tobacco, cotton and yerba maté (a kind of tea) are grown Cattle are reared and their meat and hides exported The only important town is Asuncion, the capital See map of SOUTH AMERICA

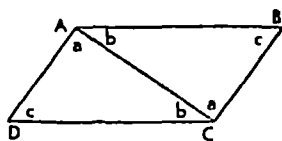
PARAKEET. See PARROT

PARALLELOGRAM See MEN-SURATION and PARALLELS

PARALLELS. Where a straight line runs across parallel lines, the angles are equal in two sets, *a* and *b* Also any *a* + any *b* = 2 right angles The angles marked with arcs are called *alternate angles*, there is another pair of alternate angles besides this pair (*b* and *b*)



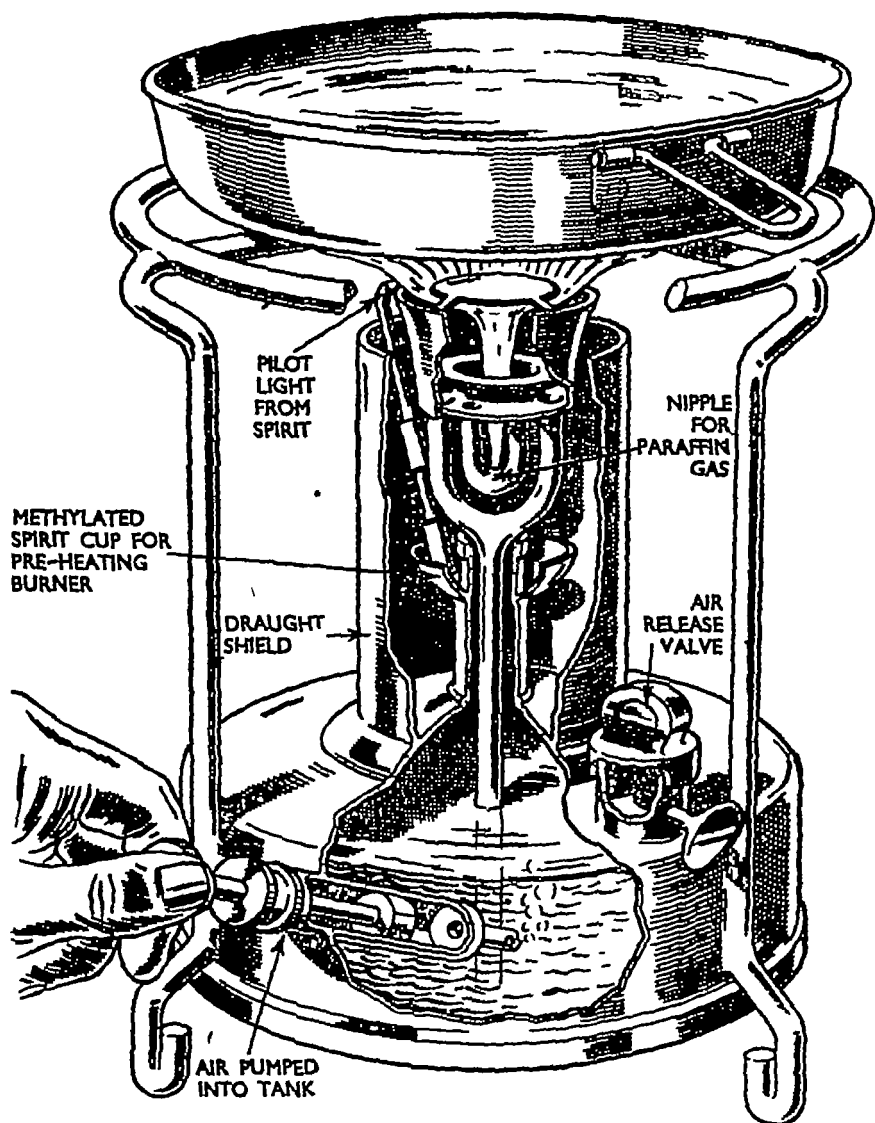
In *ABCD* opposite sides are parallel, *ABCD* is called a *parallelogram* Opposite sides are equal and opposite angles are equal (Angle *A* = angle *C*, angle *B* = angle *D*) Either diagonal bisects



the parallelogram, e.g. triangle $ACB = \text{triangle } CAD$, and angles marked a are equal, so are those marked b , and those marked c

Area of parallelogram = height \times base Hence, parallelograms on the same base and between the same parallels are equal in area See also MENSURATION

PARAPHRASE. Very often when some description or account is too difficult for others to understand, the text has to be paraphrased, i.e. rewritten in simpler language When a text is not only rewritten but condensed as well into a much shorter version, then we have a *precis* of the original



Inside the paraffin gas cooking stove, showing how it works

PARASITE. An animal or plant which depends on another for its food, and often lives on or in the organism attacked. Among plants, mistletoe lives as a parasite on certain trees, dodder on certain plants. Animals may be temporary parasites, such as fleas or lice, or permanent, such as flukes and tapeworms. Permanent parasites show very specialized forms, since they often live in alimentary canals or blood-streams. Parasites lay abnormally large numbers of eggs. Some parasites cause serious diseases in man and other animals, while others may be harmless, and some are even useful for attacking other harmful animals.

PARIS, in CLASSICAL MYTHOLOGY, is the younger son of Priam, King of Troy, who carried off Helen, wife of Menelaus, King of Sparta, and so caused the Trojan war.

PARLIAMENT. The British Parliament is often called the mother of Parliaments as other democratic countries have in some degree modelled their parliamentary systems on it. It consists of two houses, the House of Lords and the House of Commons. See **BILLS** (PROCEDURE IN PASSING).

The *House of Lords* is not elective. It consists of the Lords Spiritual (the two archbishops of Canterbury and York, and twenty-four bishops), and the Lords Temporal, that is, those with the title of baron or higher, with representative peers from Scotland and Northern Ireland. The Lord High Chancellor presides. At one time the Lords had more power than the Commons, but it has today lost much of its power. By the *Parliament Act* of 1911 (amended 1948) it was enacted that the House of Lords cannot interfere in money matters (see **TAXATION**), and that if a Bill is passed in two successive sessions in

the House of Commons and is rejected on both occasions by the House of Lords, it becomes law one year after its first passing by the Commons, in spite of the wishes of the Lords. The House of Lords acts as a kind of revising chamber and often makes amendments which the Commons accept. The Lords act as the final Court of Appeal in law cases. But normally only lords who have had legal experience choose to take part.

The *House of Commons* from 1950 has 625 elected members. The House is elected for five years and then there is a General Election. If a member dies or resigns (see **CHILTERN HUNDREDS**) or is created a peer, a special election is held in the constituency he represents. Such an election is called a by-election. The election procedure is similar to that for local bodies. See **TOWN OR BOROUGH COUNCILS**. Parliament may be dissolved any time before the expiry of five years, but only in very special circumstances (such as a war) does it pass an act to prolong its existence beyond five years.

See **HOUSE OF COMMONS**.

Government and Opposition. After a General Election the King sends for the leader of the party which has gained the largest number of seats in the House of Commons and asks him to form a Government and become Prime Minister. The other party or parties form the Opposition, whose members may speak and vote against the proposals of the Government.

The **PRIME MINISTER** invites certain of his supporters to accept office in the Government. In accepting office, they become heads of the great departments of State staffed by civil servants and responsible for branches of the Government. The chief of these heads, together with

others whom the Prime Minister may appoint, form a Cabinet of about twelve to twenty-four ministers who collectively discuss policy and direct affairs of State

The following are the chief departments of State (1) *The Treasury*, which looks after the finances of the nation In charge of it is the Chancellor of the Exchequer Each year in April the Chancellor opens his budget in the House of Commons and tells the members how he intends to raise money and how much he intends to allocate to each of the departments for carrying on its work The debates on the budget take a long time and there are various stages in the debates, but when the House of Commons has accepted the Chancellor's proposals they become law See **TAXATION** (2) *The Home Office*, the head of which is the Home Secretary, deals with police, aliens, prisons, approved schools, conditions in factories, etc (3) *The Foreign Office*, the head of which is the Foreign Secretary or Secretary of State for Foreign Affairs, is in control of our relations with foreign countries The Secretary is assisted by ambassadors appointed to represent Britain at foreign courts So, too, in Britain foreign ambassadors are attached to the Court of St James's, as the King's court is called Ambassadors have usually an official residence and are assisted by a staff of officials—secretary, military attaché, naval attaché, etc, belonging to the Diplomatic Service Attached to the Foreign Office, too, are the British consuls appointed to look after the interests of British subjects and British trade in important towns abroad (4) *The Commonwealth Relations Office*, under its Secretary of State, deals with the self-governing dominions See

BRITISH COMMONWEALTH OF NATIONS (5) *The Colonial Office*, under the Colonial Secretary, deals with the colonies (6) *The War Office*, under the Secretary of State for War, deals with the Army (7) *The Admiralty*, under the First Lord of the Admiralty, deals with the Royal Navy (8) *The Air Ministry* has charge of the Royal Air Force under the Secretary of State for Air (9) *The Scottish Office*, under the Secretary of State for Scotland, deals with Scottish affairs — education, agriculture, fisheries, health, etc (10) *The Board of Trade*, under the President of the Board of Trade, deals with matters connected with trade There are other ministries, including the Ministries of Education, Transport, Labour, Health, National Insurance, Agriculture and Fisheries, and the Post Office

PARNASSUS is a mountain in Greece, sacred to **APOLLO** and the **MUSES** See classical **MYTHOLOGY**

PARROT, with the cockatoo, mackaw, parakeet and budgerigar,



Parrot, a bird that mimics man

a group of birds living chiefly in trees in warm countries, on fruit and some grain. They are often brilliantly coloured, and have piercing and harsh voices. They are imitative, and the grey African parrot, especially, learns to talk in captivity. They may live to a great age.

See also **CAGE BIRDS**

PARTNERSHIP, an arrangement between two or more persons for business purposes. A Deed of Partnership is drawn up which defines each person's rights and share in the assets and profits of the business. A partnership has the advantage of bringing in greater capital and greater diversity of business ability than a one-man business is likely to possess. But it suffers from the fact that partners may disagree or dissolve the partnership.

PARTS OF SPEECH. See **GRAMMAR**

PASSOVER, the great feast of unleavened bread which the Israelites kept before they left Egypt, and which the Jews have always kept in memory of their deliverance from Egypt by God.

PASSPORT, a document issued by the competent authority permitting the person named in it to travel in certain countries and requesting "all those whom it may concern to allow the bearer to pass freely without let or hindrance and to afford him (or her) every assistance and protection of which he (or she) may stand in need." It contains the holder's name, nationality, place and date of birth, profession, physical characteristics, and a photograph, and names the countries for which the passport is valid. In Britain passports are issued by the Foreign Office but they can be obtained on application through any Labour Exchange.

PASTEUR, Louis (1822-1895), was the French biological chemist and bacteriologist who discovered the part that germs play in causing diseases and proved that they were not born spontaneously as was once supposed.

During his research Pasteur found that fermentation was due to the action of microbes (see **BACTERIA**) and that sourness in milk and wine was due to a like cause.



Pasteur found germs cause disease

He set out to find whether this sourness could be prevented, and discovered that, by raising the temperature of a liquid sufficiently, harmful germs and those causing fermentation in it were destroyed. This provided the basic knowledge for the process of pasteurization today used for preserving food particularly milk.

He also studied epidemics in birds, animals and human beings, and established that anthrax, which killed cattle, and chicken-cholera, which carried off fowls, were both due to different germs. Having succeeded in isolating the chicken-cholera germ, he accidentally infected some healthy fowls with weak

chicken-cholera virus so that they had the disease only temporarily and in a very mild form. Later he injected into the same fowls a strong virus. This time they did not take the disease at all. The mild infection had made them immune from the disease. Thus he discovered a method of preventing the disease. By injecting a weak virus of the chicken-cholera into a fowl it would be made immune from catching the disease seriously—the germ of the disease was its own prevention. See INOCULATION.

Another piece of research undertaken by Pasteur was in connexion with rabies or hydrophobia, a disease caused in man by the bite of a mad dog suffering from the disease. Here again Pasteur managed to evolve a method of inoculation by which the disease was controlled. In the first place he confined his treatment to animals, but afterwards human beings (who in those days used to die of rabies) were successfully treated.

The outcome of Pasteur's work and discoveries was the founding of the Pasteur Institute in Paris to extend the study of the application of the method of inoculation against disease. Here Pasteur worked from 1888, and here and elsewhere today scientists prepare vaccines for the prevention of typhoid, cholera, and other diseases.

PASTORALISTS are people who live by rearing large numbers of animals such as cattle, sheep, horses and camels. Where the natural grasslands or pastures depend on seasonal rainfall, the pastoralists often move from place to place; they are then said to be **NOMADS**.

PASTORAL POETRY, mainly lyric, is that in which the poet idealizes the delights and beauties of country life and the picturesque

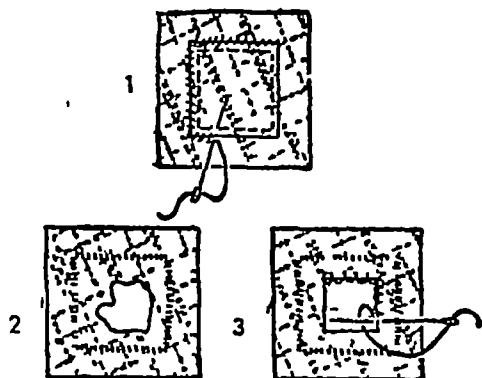
shepherds and shepherdesses whom he imagines to abound there.

PASTRY-MAKING. The ingredients of pastry are (1) Flour which should be fresh, dry, and without lumps (2) Fats, chiefly lard, butter, margarine, dripping, or suet. These must be fresh, for any slight bad flavour becomes more noticeable after cooking (3) Baking powder used to lighten the pastry (4) Water, which should be just sufficient to get a pliable pastry. Usually $\frac{1}{2}$ pint is required to 1 pound flour. Too much water makes a tough pastry. Well-made pastry should be light, and short or flaky. Sour milk may be used instead of water, omitting the baking powder. The chief kinds are *short pastry*, *flaky pastry*, *rough puff pastry*, and *suet pastry*.

Making up short pastry. To ensure lightness introduce plenty of cold air into the pastry by sieving the flour, salt, and baking powder, working in a cool place, and keeping materials and utensils cold. Let water run from the tap for some time before using any for pastry. Be accurate in measuring out quantities. Make all preparations before mixing the pastry, e.g. light oven, grease tins, prepare fillings for tarts, have fillings for meat pies, where these are to be cooked first, ready and cool. In rubbing in fat, cover it with flour and break it up, using the tips of the fingers only, until it is like fine breadcrumbs. Mix to a stiff, smooth, elastic dough which leaves the sides of the bowl clean. Before rolling out the pastry, flour the rolling-pin and the board. Roll lightly in one direction only and do not turn the pastry over. Handle the pastry as little as possible. For tarts and pies roll to a shape slightly larger all round than that required. This method allows strips for the edges.

PATCHING is used when a hole is large and is surrounded by an area of worn material. The patch material should match that of the garment very closely, if possible a piece of the garment should be used if it can be taken without damage to the garment. New material should be washed before it is used. Sewing threads must be chosen carefully—a clumsy effect would result if a thick thread were used on a fine material. In patching thin fabrics, threads, needles and stitches should be fine. With patterned materials and garments worn next to the skin, patches are placed on the right side, in all other cases on the wrong side. The weave of both patch and garment should coincide. All the weakened part round the hole must be covered, or the patch may tear away from the rest. When sewing on a patch, take care not to stretch the material.

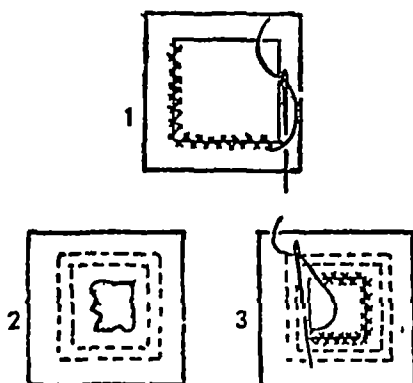
The *print patch* is used for garments, loose covers, etc., made of patterned material. Prepare the patch to match the pattern exactly, allowing $\frac{1}{4}$ inch extra all round, and turn this in. Pin in position on the right side of the garment (see 1), then **TACK** and **HEM** all round. Turn to the wrong side, cut away the worn material to within $\frac{1}{4}$ inch of



Stages in the print patch

the stitching, and **BLANKET STITCH** the raw edges, using even stitches of about $\frac{1}{4}$ inch in depth and $\frac{1}{4}$ inch apart (see 2 and 3).

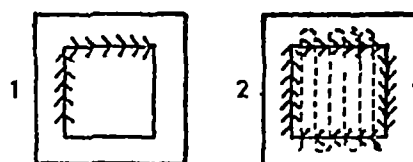
The *flannel or stockinet patch* is used for undergarments only. Find the total area to be covered by the patch, cut it accurately following the grain of the material.



Stages in the flannel patch

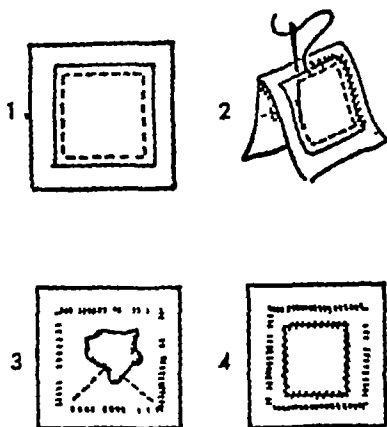
Place the right side of the patch to the wrong side of the material. Tack the patch in position, leaving the edges raw. Work **HERRINGBONE STITCH** all round the patch (see 1). Turn to the right side of the garment, cut away the worn material to within $\frac{1}{4}$ inch of the stitching, then secure the edges with herringbone (see 2 and 3).

For a *cloth patch* (used for thick and woollen cloth), cut the patch to exactly the size of the hole, which should be made rectangular in shape. Secure the patch in position with **FISHBONE STITCH** (see 1), and then using a thread of the material darn across patch and material (see 2).



Stages in the cloth patch

The *calico patch* is used to repair all household articles except table linen, and for undergarments made of cotton, flannelette, or silk materials. Measure the size of the patch, allowing $\frac{1}{4}$ inch for turnings



Stages in the calico patch

Place the right side of the patch to the wrong side of the garment, turn it under $\frac{1}{4}$ inch, tack in position and then hem round (see 1 and 2). Turn to the right side of the garment (see 3) and cut away the worn material, leaving a margin of about $\frac{1}{2}$ inch from the stitching all round. Notch the corners to enable them to lie flat. Turn in the raw edges, tack, and hem (see 4).

PATRICK, St., born about A.D. 389, probably in Scotland, and for a time a slave in Ireland, set out to convert the Irish, and started the Christian Church in Ireland, of which he is the **PATRON SAINT**.

PATRON SAINT, a saint who guards and protects special kinds of persons, countries or churches. The patron saints of England, Wales, Scotland and Ireland are St. GEORGE, St. DAVID, St. ANDREW and St. PATRICK respectively.

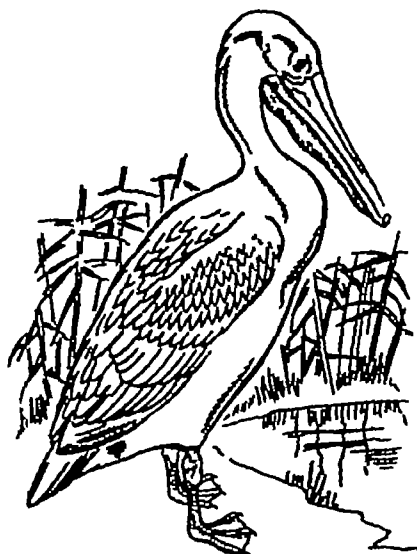
PAUL, St., the Christian missionary pioneer, was born at Tarsus, learnt tent-making, trained to be a

PHARISEE at Jerusalem, consented to the killing of STEPHEN, the first Christian martyr, persecuted the Christians, and then was suddenly converted on the way to Damascus. After three years in the desert he returned to Tarsus for fourteen years, and then started on his three missionary journeys, to Asia Minor and Europe, during which he wrote his letters to Rome, Corinth and other churches and Christians. After much suffering he was arrested in Jerusalem, taken to Rome for trial, and beheaded about A.D. 62.

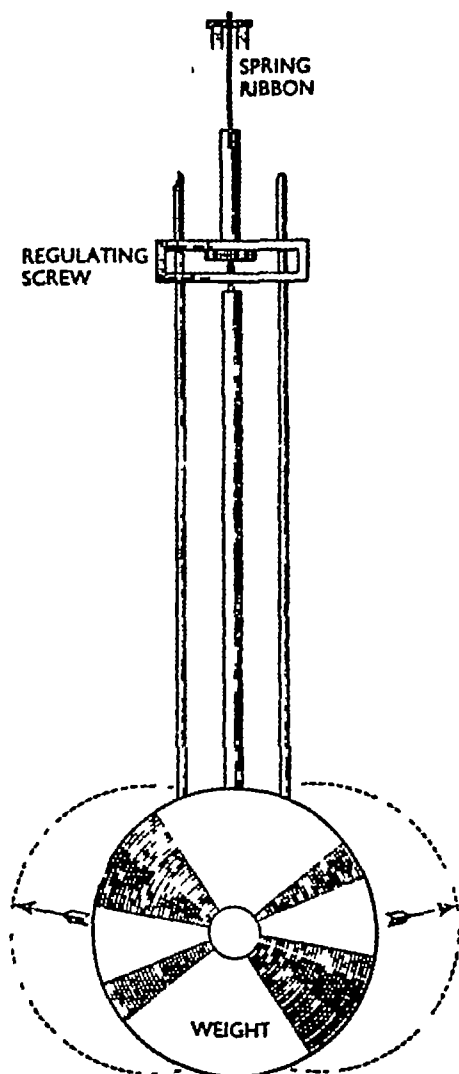
PECCARY. See **HOOFED MAMMALS**.

PEGASUS, in **CLASSICAL MYTHOLOGY**, is the famous winged horse which came from the blood of the GORGON Medusa, when her head was struck off by PERSEUS. A blow by his hoof produced the spring on Mount HELICON which was sacred to the MUSES. See also CHIMAERA.

PELICAN, a semi-tropical water bird, with a huge beak. The skin below the beak or bill forms an extensible pouch for temporary



Food is stored in the pelican's bill



Pendulum of a clock

storage of fish. Pelicans look clumsy on the ground but have a beautiful flight, the flocks often flying in V-formation.

PELOTA is the national game of the **BASQUES**. In some ways it resembles the game of **FIVES**, but the ball is thrown with a curved wicker scoop which is attached to the hand.

PEMBA. See **ZANZIBAR AND PEMBA**.

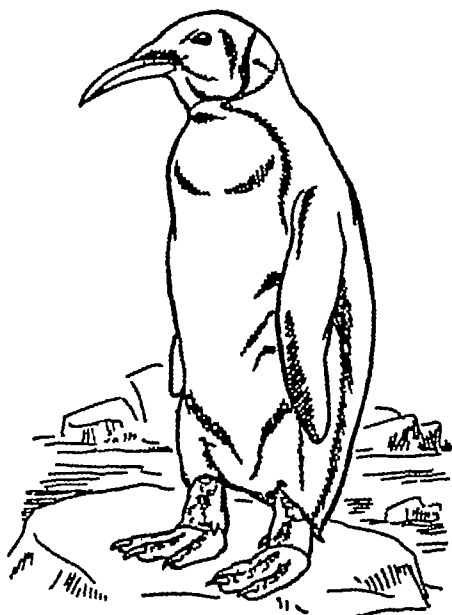
PENDULUM. The simple pendulum is a heavy weight or bob on the end of a light thread which

swings to and fro at regular intervals. The length of the interval depends on the length of the thread and not on the weight or composition of the bob.

In a grandfather clock, the pendulum controls an escapement which allows the wheels to turn the hands at a regular rate. Here the pendulum rod is of metal, sometimes of **INVAR**, and the bob is controlled by a compensating mechanism so that temperature changes do not alter the time of swing. Its length and time of swing can be regulated by a screw.

PENELOPE is the wife of **ODYSSEUS**.

PENGUIN, a black and white fish-eating sea-bird, forming large flocks in the Antarctic. On land, penguins stand erect, emperor penguins reaching 3 feet in height. The eggs, in a nest of stones, are held in a fold of skin between the feet for incubation, mother and father taking turns to sit on them. Penguins swim but cannot fly.



Penguins live amidst the ice

PENICILLIN. See ANTI-BIOTICS and FUNGUS

PENINSULA, a piece of land extending far into the sea like a



Peninsula, almost an island

limb Cornwall is an example of a peninsula

Sometimes a peninsula is almost, but never quite, surrounded by water

PENTECOST means "fiftieth" the Feast of Weeks or Harvest Thanksgiving was kept in the Old Testament fifty days after the PASSOVER The Holy Spirit came to the disciples at the Feast of Pentecost Christians call it also Whit Sunday, and keep it on the seventh Sunday after Easter See SEASONS OF THE CHURCH

PEPYS, Samuel (1633-1703), was the author of the most famous DIARY in English, covering 1660 to 1669, when his sight began to fail It records his gradually increasing prosperity and importance (he became Secretary to the Admiralty) as well as his domestic life and personal failings, and throws a very interesting light on everyday life of the times The diary was written in a shorthand devised by himself and was not deciphered until 1822

PERCENTAGES. Per cent means per 100, 5 per cent means 5 out of every hundred, $\frac{5}{100}$ or 05 (four ways of saying the same thing) We often write 5 per cent as 5%

(1) To turn a percentage into a FRACTION, write the percentage as a fraction over 100

$$5\% = \frac{5}{100} = \frac{1}{20}$$

$$10\% = \frac{10}{100} = \frac{1}{10}$$

$$12\frac{1}{2}\% = \frac{12\frac{1}{2}}{100} = \frac{25}{200} = \frac{1}{8}$$

$$25\% = \frac{25}{100} = \frac{1}{4}, 50\% = \frac{50}{100} = \frac{1}{2}, 75\% = \frac{75}{100} = \frac{3}{4}$$

$$33\frac{1}{3}\% = \frac{33\frac{1}{3}}{100} = \frac{100}{300} = \frac{1}{3}$$

(2) To turn it into a DECIMAL, remember that 1 per cent is $\frac{1}{100} = 01$, so we can at once write any percentage as a two-place decimal

$$6\% = 06 \quad 10\% = 10 \text{ or } 1$$

$$15\% = 15$$

$$\frac{1}{2}\% \text{ is half of } 1\% =$$

$$\frac{1}{2} \text{ of } 01 = 005$$

$$\frac{1}{4}\% \text{ is quarter of } 1\% =$$

$$\frac{1}{4} \text{ of } 01 = 0025$$

$$\frac{3}{4}\% = 0075$$

If a percentage includes $\frac{1}{2}$ we add 005, if $\frac{1}{4}$ we add 0025, if $\frac{3}{4}$ we add 0075

$$7\frac{1}{2}\% = 075 \quad 12\frac{1}{2}\% = 1225$$

$$2\frac{1}{2}\% = 0275$$

(3) To find 6% of 387 (a) we can multiply by 06, (b) or we can find $\frac{1}{10}$ of 387 = 38.7, and multiply by 6 To find 10%, 20% and other percentages which form easy fractions, we divide by 10 for 10%, by 5 for 20%, by 4 for 25%, and so on

(4) To find percentages of money it is often advisable to decimalize the money Thus, to find $4\frac{1}{2}\%$ of £86 5s, we multiply £86 25 by 045 The percentage is

$$\begin{array}{r} \text{£}86 \text{ } 25 \\ \times 045 \\ \hline \end{array}$$

$$4325$$

$$34500$$

$$43125$$

$$\underline{\text{£}3 \text{ } 88125} = \text{£}3 \text{ } 17s \text{ } 7\frac{1}{2}d$$

(5) To find what percentage one quantity is of another we write the first quantity over the second and multiply by 100 (add two 0's to the

numerator) Thus, to find what percentage 347 is of 394 we write.

$$\frac{347}{394} = 88.07\%$$

(6) To find what percentage 15s 9d is of £1, write $\frac{15s\ 9d}{£1}$

We next change both sums of money to pence or to threepences, and then multiply the numerator by 100 We get

$$\frac{189}{216} \times \frac{100}{1} = 87.5\%$$

(7) Now look at this example 4 parts out of 7 of an alloy are copper, and the remainder is tin What is the percentage composition?

$$\text{Copper } \frac{4}{7} \times \frac{100}{1} = 57\frac{1}{7}\%$$

$$\text{Tin } \frac{3}{7} \times \frac{100}{1} = \frac{3}{7} \times \frac{100}{1} = 42\frac{6}{7}\%$$

See also INTEREST

PERCUSSION CAP, a small container holding a portion of explosive which explodes on being struck It is used to set off the main explosive charge for propelling cartridges

PERCUSSION INSTRUMENTS are instruments the sounds of which are produced by banging of some kind The most important in the orchestra are the kettle drums, which can be tuned to a definite note Other percussion instruments are the side drum, bass drum, castanets, triangle, cymbals, tambourine, tubular bells, glockenspiel (formerly little bells, but now steel plates), celeste (steel plates struck by hammers operated by a keyboard like a piano) and xylophone (wooden bars struck by small hammers) See ORCHESTRA, and pages 404-405

PERENNIALS are those plants like delphinium, hollyhock, lupin, michaelmas daisy, primulas, and pyrethrum which continue to flower year after year Although the leaves and stems die down in the winter, new growth begins in the spring and new flowers and seeds are produced all over again

PERPETUAL MOTION. It was for many years an idea of inventors that, by a suitable arrangement of mechanism, machines could be made to run for ever For instance, if a DYNAMO and electric MOTOR were joined up, would not the current from the dynamo drive the motor and the motor in turn drive the dynamo to make more current?

The answer is "No!" The dynamo, when driven by another motive power, may generate electricity that will drive the electric motor, but that electric motor will be too weak to be the motive power for driving the dynamo, for we know that at every point in the transmission of energy there is FRICTION—the friction of driving belts revolving on wheels, the friction of wheels revolving in air, and so on—and where there is friction, energy is being lost by being converted into heat which plays no part in the work of driving a machine The amount of energy which a machine can exert in doing its work is always less than the amount of energy required to make it work

PERSEPHONE is the Greek name for PROSERPINE

PERSEUS, in CLASSICAL MYTHOLOGY, is the famous Greek hero whose most heroic deed was the slaying of the GORGON Medusa

PERSIA (Iran) consists mainly of a great PLATEAU with narrow coastal plains along the shores of the Caspian Sea and Persian Gulf The winters are cold and snow falls, but summer temperatures are high Wheat and barley are grown in spring, maize, rice and peas, tobacco and cotton in summer Hand-made carpets are exported The chief wealth of the country, however, lies in the oil-fields of the south-west Teheran, the capital of the kingdom, is connected by rail

to the Caspian Sea See map of the
NEAR EAST

PERSPECTIVE. When you stand on a railway bridge and look along a long stretch of track you will notice that the lines seem to get closer together as they go away from you Similarly, if you look at a row of houses all the same size in a terrace you will see that the house in the far distance seems to be much smaller than the nearest one This is a visual effect brought about by distance Perspective gives rules for producing this effect on a flat surface like paper or canvas It was introduced into European art in the 15th century by Uccello (e g his "Rout of San Romano")

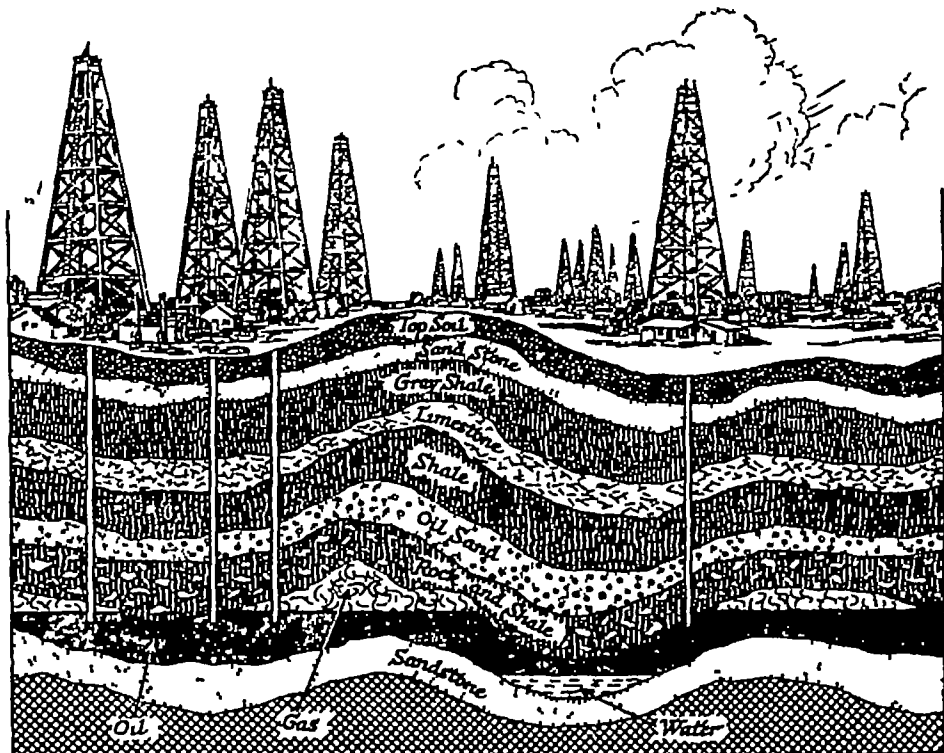
PERU lies astride the Andes in South America, the east of the country being mostly wild jungle and mountain, some of it unexplored Chief exports are cotton,

copper, petroleum, sugar and lead Most of the white population lives in Lima, the capital, Arequipa, Cuzco, and the port of Callao See map of SOUTH AMERICA

PETER, Simon, St., the brother of **ANDREW**, lived at Bethsaida in Galilee, and was a fisherman He became the chief disciple of **JESUS**, who gave him the name of Peter, which means "rock" It was Peter who cried to Jesus "Thou art the Christ, the Son of the Living God" When Jesus was in the hands of His enemies, Peter grew afraid and thrice denied his association with Jesus, but repented After the **ASCENSION** he led the Christians at Jerusalem, and went on missionary journeys He had a wonderful deliverance from prison but may have died a martyr about A D 64 in Rome, of which he is said to have been the first Bishop The



In perspective parallel lines recede to the same vanishing point



In this oil-field, wells have been sunk down to the petroleum

POPES, as Bishops of Rome, claim direct succession from St. Peter

PETRARCH (1304–1374) was an Italian poet who by his researches into old Greek and Latin literature helped on the RENAISSANCE in which medieval minds were enlightened by re-discovering the thought and poetry of past civilizations. He was, too, the perfecter of the sonnet form later to be adapted from him by English and French poets.

PETROLEUM. This term covers all the HYDROCARBON products which are obtained in a gaseous or a more or less liquid state from certain porous rocks in the earth. The source of crude petroleum is thought to be decayed remains of tiny sea plants and animals which have been covered by clay and sand and subjected to the influences of temperature, pressure and water filtration as they lay buried in the ground. When a well is sunk to

the oil-bearing level, the oil may gush out naturally, otherwise pumping machinery is installed. The oil, when it comes out of the bore hole, may contain a lot of gas, which can be used later for power and light. Oil is often carried to ports and refineries by pipelines, some of them hundreds of miles long.

By DISTILLATION and refining (see RETINERY) of the crude oil we obtain petrol, paraffin or kerosene, diesel oil, lubricating oils, fuel oils, benzine, naphtha, and paraffin waxes of all kinds.

The world's most productive oil-fields are in the UNITED STATES OF AMERICA, the UNION OF SOVIET SOCIALIST REPUBLICS, VENEZUELA, RUMANIA, the EAST INDIES, PERSIA and nearby areas.

PEWTER is an alloy of tin and lead, sometimes with small amounts of copper and antimony. It can be

beaten and formed into ornamental shapes without cracking, and was originally used for making plates and mugs

PHARISEE, a member of a Jewish sect in the time of Christ, which stressed the keeping of the smallest points of the Jewish Law

PHILIPPINES. See **PACIFIC OCEAN**

PHILISTINES were a powerful fighting people who entered Palestine, which is named after them, about the same time as the Israelites, but on the seaward side, and who were continually fighting against the Israelites. Saul struggled against them and DAVID succeeded in defeating them

PHOENICIANS, living in Phoenicia, a narrow strip of coastland between the mountains of Lebanon and the Mediterranean, were the greatest sailors of the ANCIENT WORLD. From their ports of Tyre and Sidon, they sailed along the coasts of the Mediterranean, setting up trading-posts at suitable points. The carrying trade of the ancient world was almost entirely in their hands. The Phoenician craftsmen also supplied valuable cargoes of manufactured goods, especially the Tyrian purple cloth dyed in a secret way. They are said to have discovered the way to make glass. See **ROME**

The Phoenicians were the inventors of the alphabet. They found the old picture writing and wedge-shaped writing of the East too difficult for general use, and made a series of characters, which we call "letters," which could be put together to make words. The Greeks copied these letters, and added a few more, the Romans learned them from the Greeks, made a few more changes, and so gave us the twenty-six letters that form our modern alphabet

PHOENIX, a legendary bird which, after 500 years, builds itself a funeral pyre and dies on it, a fresh phoenix always rising from its ashes

PHONETICS is the science of the pronunciation of languages. By phonetic symbols we can represent more accurately the sounds of spoken words than by ordinary letters

PHOSPHORESCENCE. When certain substances are exposed to the air they give off a faint glow without appreciable heat. This ability is shown by certain sulphides used in luminous paint, as well as by yellow phosphorus. Decaying fish and certain types of plant are phosphorescent

PHOSPHORUS is a yellow wax or red powdery ELEMENT. In the former state it is very inflammable, and in the latter fairly so. When they burn, they both give off choking fumes of phosphorus oxide

Yellow phosphorus catches alight in the air at a low temperature, it glows in the dark, and it is extremely poisonous. Large quantities of phosphorus compounds are used in **FERTILIZERS**

PHOTO-ELECTRIC CELL, a piece of electrical apparatus which responds to light falling on it, either by lowering its resistance or by giving out a current. When the light reaching the cell is interrupted by, say, something passing in front of it, the effect can be registered on an indicator. These cells are used in automatic machinery control, counting machines and burglar alarms, in reproducing the sound track in talking pictures, in **TELEVISION**, and in the **TELEGRAPHIC TRANSMISSION OF PICTURES**

PHOTOGRAPHY is the art and science of making light images formed in a **CAMERA** into a permanent picture. The chief method

is based upon the change which occurs in many silver compounds when light falls on them

At the back of the camera is a glass plate or a film covered with a thin jelly containing a sensitive silver compound. When the light falls on the plate, the silver compound is altered according to the intensity of the light in the various places. The plate is then removed in a dark room and developed. In this process the affected silver compound turns black. The plate is then fixed, a process in which all the unaffected compound is dissolved away. After washing and drying, a negative is obtained in which all the bright parts of the image appear dark and vice versa. This negative is placed over a piece of paper which also has a sensitive surface, and then light is allowed to pass through the negative on to the paper. Where the negative is black, the paper is unaffected, but where it is clear the light passes through. This paper or print is now fixed in the same way as the negative, some printing papers need to be developed first before fixing. We now have a positive reproduction of the original light image. After the print has been washed, it can be hung up to dry, in which case it will have a natural surface, but if we wish to have a glazed surface, the print should be at once placed, picture-side down, on to a clean sheet of glass and smoothed down with a roller and allowed to dry. Photographs are best kept mounted in an album.

The cinematographic camera takes its negatives on a long strip of film which is jerked through the camera, stopping for a fraction of a second while the lens shutter is open. The positive film is printed just as the paper print, except that there are transparent areas instead

of white unaffected paper. See CINEMATOGRAPHIC PROJECTOR.

The modern uses of photography are innumerable, and range from microphotographs, which tell us about the crystal structure of metals or the life of microscopic animals, to aerophotography which enables us to map an area.

PHOTOMETER, an instrument used to measure the intensity of lighting at a given place, or to measure the candle power of a light.

PHOTOSYNTHESIS is the process whereby a green plant builds up the CARBON DIOXIDE of the air into sugar and starch. The energy needed to do this is obtained from the sunlight. CHLOROPHYLL, a green-coloured substance, must also be present in the leaves to help this process, during which oxygen is given off. See LEAF.

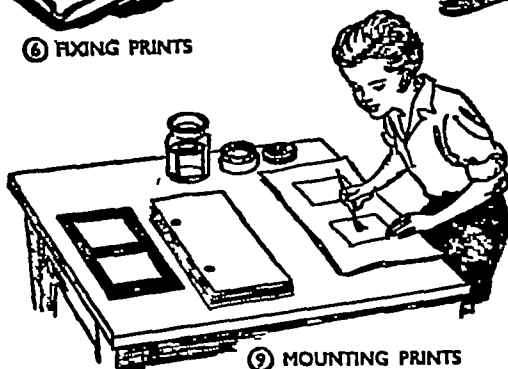
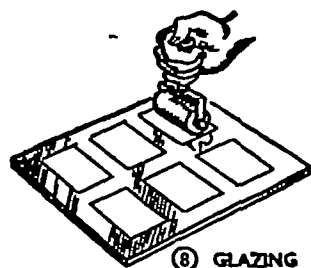
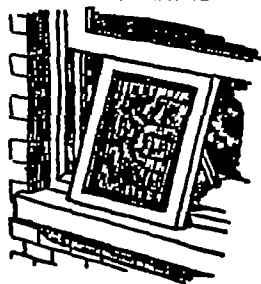
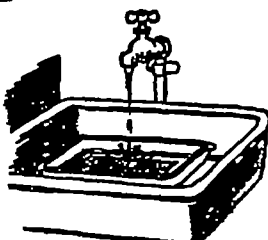
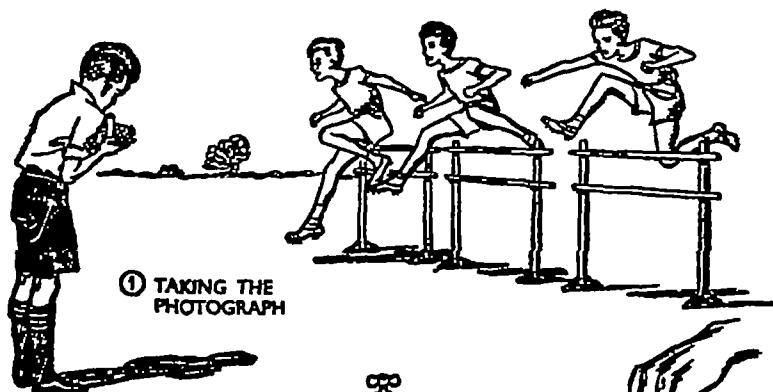
PHOTOTELEGRAPHY. See TELEGRAPHIC TRANSMISSION OF PICTURES.

PHRASE. See GRAMMAR and SYNTAX.

PHYSICAL EXERCISES Every boy or girl can keep fit by doing a few simple exercises every day. The best time is when you get up in the morning. The fewer clothes you have on the better your body can move, and if you cannot be out of doors, stand facing an open window and get all the fresh air you can. Always remember to breathe *in* through the nose, *out* through the mouth. Do the exercises without jerking, but do every movement thoroughly.

Here are a few exercises to start with.

(1) For chest expansion, stand firmly as straight as you can with legs apart, (a) breathing in through nose, bring arms up with hands on chest, (b) stretch arms fairly slowly out to side and as far back as they



Here are the various stages in photography for those boys and girls who have a camera and would like to do their own developing and printing

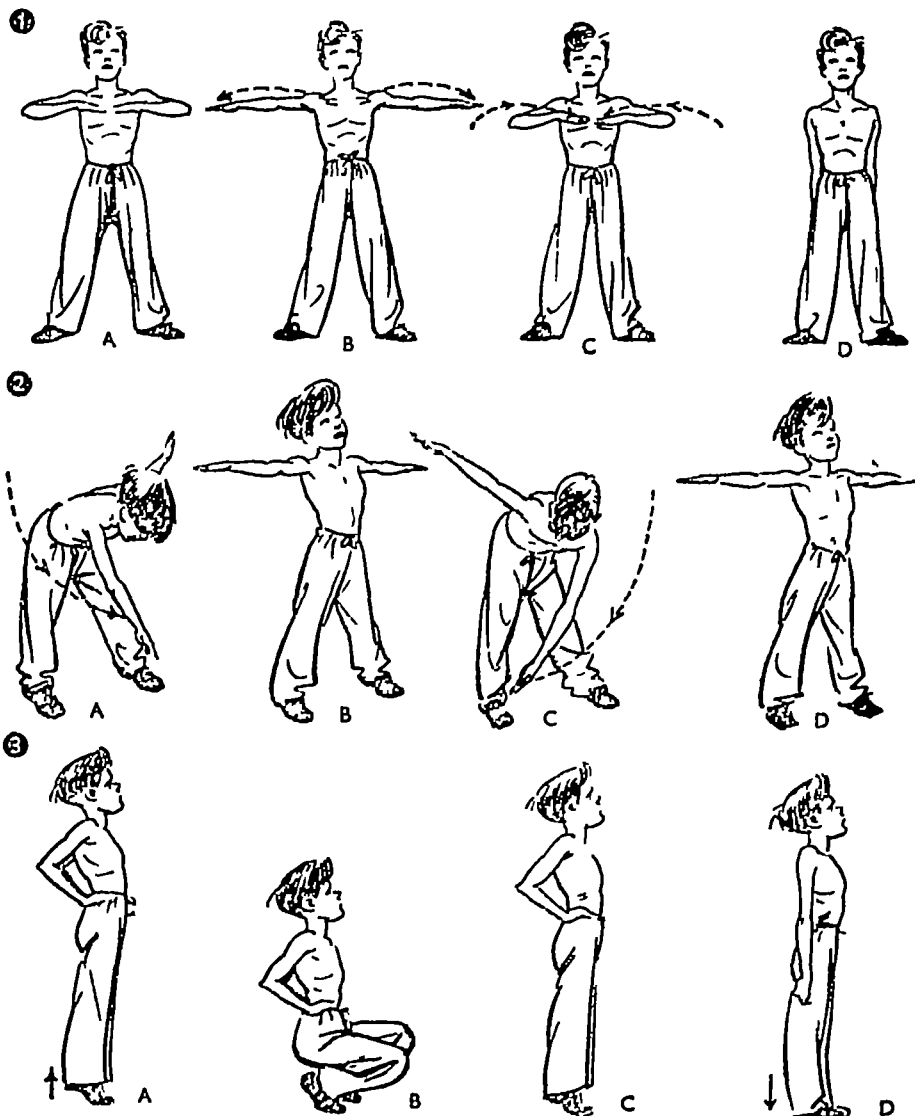
will go, (c) breathing out, bring arms back to chest, and (d) lower to sides. Repeat fairly slowly, stretching the arms just a little farther back each time.

(2) For the abdominal muscles, stand with legs apart and arms raised out to sides. (a) with right arm touch left toe, keeping head well down and *knees stiff*, (b) up again into position with arms out to sides and head high, (c) with left arm touch right toe, (d) up to

standing position. Repeat quickly.

(3) For the leg muscles, hands on hip, feet together. (a) heels raise, (b) bend knees out so that you sit on heels (keep back straight and don't wobble), (c) knees stretch (you are now on tiptoe with heels still touching), (d) heels lower. Repeat slowly, breathing in on (a) and (b), holding for (c), out on (d).

(4) A quick exercise to end with hands on hips, feet together, spring about twenty times as lightly as



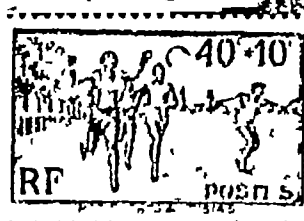
A few simple exercises every morning will help to keep you fit



HUNGARY



GERMANY



FRANCE



BELGIUM



COSTA RICA



CEYLON



ITALY



AUSTRIA



NETHERLANDS



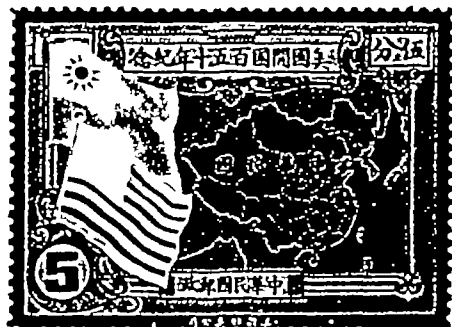
SPAIN



GT BRITAIN



BULGARIA



CHINA



DENMARK

Selection of postage stamps showing their variety in subject shape size and colour



When a coloured picture is to be printed in colour, it is first photographed through various colour-filters one photographic negative will register all the yellows in the original picture, a second the reds, a third the blues, and a fourth the blacks. Metal plates are then made corresponding to the four negatives these metal plates would give the four prints shown above if printed separately, using the appropriate coloured ink in each case, but when they are printed one after the other on to the same area of paper the effect is as on the left (see PRINTING). This painting, "The Artist on His Way to Work," is by Vincent van Gogh (reproduced by permission of the Magdeburg Museum)

possible on the same spot, keeping heels together and letting ankles and knees "give" each time you land on the floor

Finish off with a few deep breaths

PHYSICS This is the shortened form of the phrase "Physical Science" It can include almost any branch of scientific knowledge which deals with non-living things By custom, however, physics is thought of as comprising MECHANICS, SOUND, MAGNETISM, static and current ELECTRICITY, radiation and transmission of HEAT, light and electrical ENERGY and such properties of matter as DENSITY and SURFACE TENSION Recently the branches of physics dealing with the structure of the ATOM and of the universe have made great advances

PHYSIOLOGY is the study of the working of the living body, of how each part performs its particular function, and of how all work harmoniously together

See such entries as ALIMENTARY CANAL, BLOOD, EAR, EYE, MUSCLE, NERVOUS SYSTEM, RESPIRATION, SKELETON, SKIN, TOOTH, etc

PIANO-ACCORDION See REED INSTRUMENTS

PIANOFORTE, the modern KEYBOARD STRINGED INSTRUMENT which has superseded the harpsichord and other early keyboard instruments It gets its name from the fact that it can be played soft (*piano*) or loud (*forte*) according to the pressure on the keys From the illustration on p 450 it will be seen that pushing a key down causes a felt damper to be lifted off the appropriate set of strings while at the same time a hammer swings forward to strike the strings and recoil slightly The strings thus struck continue to vibrate until the key is released, when the felt damper falls on to the strings again and stops the vibration Of

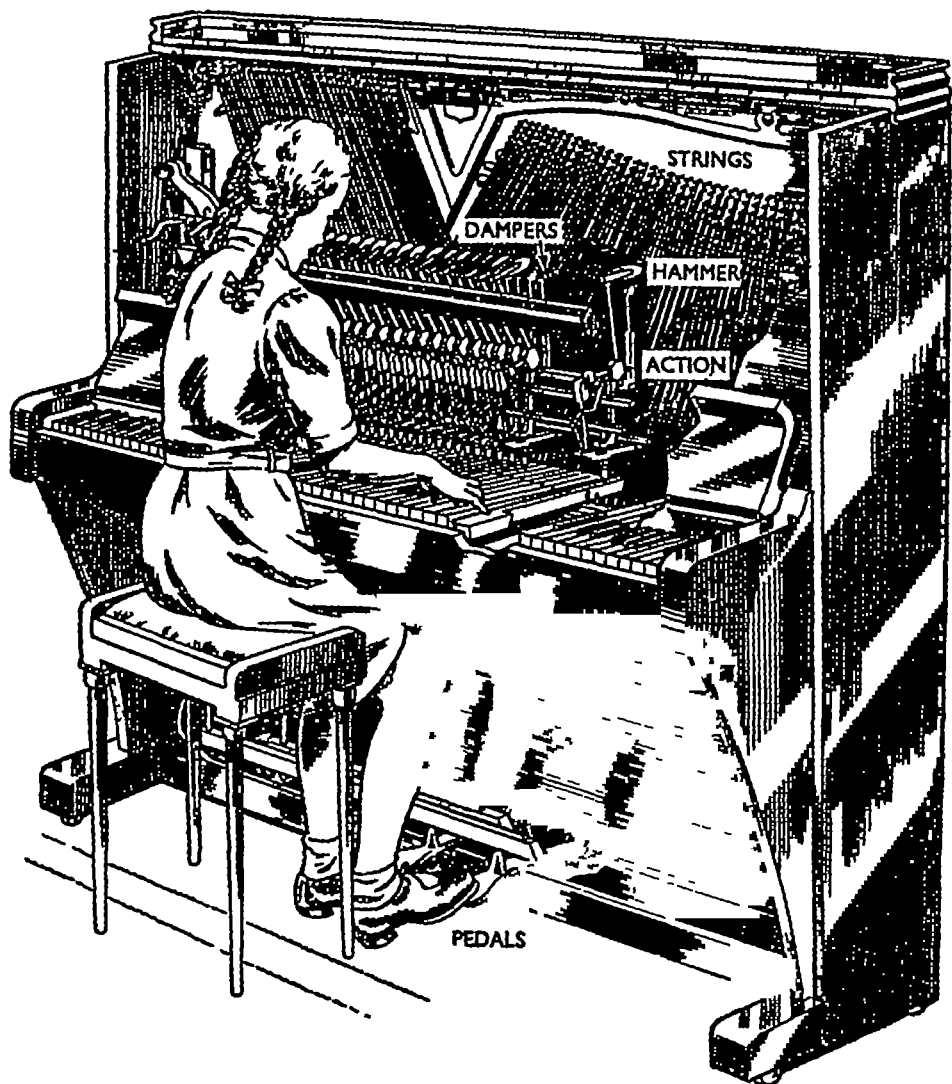
the two foot pedals, the right-hand one when depressed causes all the dampers to be lifted up, thus allowing struck strings to vibrate even after the key has been released The left-hand pedal, when depressed, makes the ensuing notes softer, either by bringing the hammers nearer the strings, or by shifting the whole action (i.e. the striking mechanism) sideways so that the hammers strike only one of the three strings for each note, or by some other means The range of the modern piano keyboard is 7 or $7\frac{1}{2}$ octaves, and most music can be adapted to it

PIANO-PLAYER, a piano which plays automatically It has a mechanism, worked by the feet or electrically, to which are fed long rolls of paper, perforated with holes according to the notes that are to be played

PICCOLO, a small FLUTE with a shrill, high-pitched sound Picture on page 404

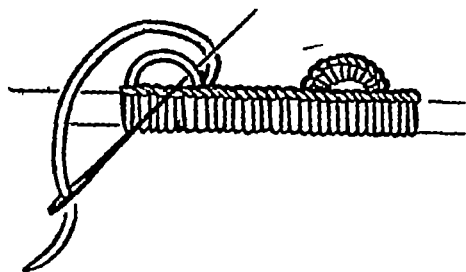
PICKLING is the preserving of vegetables and fruit in vinegar containing certain other ingredients to increase the flavour Red cabbage, cauliflower, onions, green walnuts, damsons and plums make favourite pickles Good malt vinegar should be used When pickling crisp vegetables like cabbage, cauliflower and onions, the vinegar is boiled with the spices and allowed to cool before use, for plums, walnuts, damsons, it is used when hot The jars should be of glass and wide-necked The vinegar must cover the contents of the jar, but should be some little distance from the cover Screw or clip tops may be used, the aim is to exclude air An aluminium pan is best for boiling the vinegar and spices

PICOT EDGING Picots are worked in an edge finished with BLANKET STITCH or BUTTONHOLE



How the strings of the pianoforte are made to sound (see page 449)

STITCH The most easily worked picot is that which is part of the buttonhole stitch. The thread is looped and held by means of a pin,



One picot is already made

and then covered with buttonhole stitch. Make picots at regular intervals.

PIED PIPER, the subject of a legend of Hamelin, a town in Brunswick, which was plagued with rats. The Piper charms the rats away, but being defrauded of his reward, he then charms the children away to a hill, inside which they disappear. **BROWNING** retold the story in verse.

FIG. See **HOOTED MAMMALS**

PIGEON. See **DOVE AND PIGEON**

PIGEON AS A PET. Fantail

and other ornamental pigeons are usually housed in a pigeon-cote mounted on a post or fixed out of reach of cats on a sunny wall. Homers should be kept in a loft or house solidly built of tongue-and-grooved timber, well creosoted, with a roof made watertight with felt and a cement floor raised a few inches above ground level. Perches, one for each pigeon, must be provided. These should be of wood, about 2 inches by 4 inches, projecting from the walls of the loft at about 6 feet from the ground and at least 12 inches apart. The loft should be in three compartments, the middle one for young birds and the other two for adult cocks and hens, since these must be separated except during the mating season. Cleanliness is essential. The inside of the loft or cote should be limewashed every spring and autumn. Perches must be scraped constantly and the floor of the loft supplied with clean sand, peat-moss or sawdust.

Buy your birds in the spring. Accustom them to their new quarters by covering the verandah of the cote with wire-netting and keeping them confined for about a fortnight before freeing them.

Feed your birds on the seed mixture suitable for their particular breed. You can buy this from pet stores or corn chandlers. If your pigeons are kept permanently in their loft or in an aviary they will need chopped raw green vegetables two or three times a week. All pigeons need a grit box filled with a mixture of sand, crushed oyster shell, old mortar and a little slaked lime. A lump of rock salt should be left in the grit box.

Plenty of absolutely clean water is essential. Use any of the drinking fountains specially designed for pigeons. Your ironmonger or pet

storekeeper will advise you. Give the pigeons a bowl of water for bathing every day in hot weather and twice a week during the winter, but remove it when the birds have finished. They must not be allowed to drink their bath water!

If you want to breed from your pigeons, introduce your cock and hen to each other in a nesting box with a wire front and a wire slide between them. The slide may be removed later. In a day or so you can introduce a nesting pan with sawdust and a little straw in it. Leave a few wisps of straw lying about for them to add to their ready-made nest. A fortnight after the eggs are laid (there will only be two) you must give the parents a special seed mixture so that they may produce the "pigeons' milk" with which they feed their young when hatched.

When you are quite sure that the young pigeons can feed themselves, they may be removed to the middle section of the loft. This should be about a month after hatching.

Parasites should be avoided if the nesting boxes and perches are kept clean and regularly disinfected. See also DOVE AND PIGEON.

PILGRIM FATHERS, the name given to a party of PURITANS—seventy-four men and twenty-eight women—who left England in 1620 to find a new home in America, where they would be free to worship God in their own way. They sailed from Plymouth in the *Mayflower*, and landed in Cape Cod Bay more than two months later. They founded a township in the New World, the first permanent settlement by Europeans, which they named Plymouth, after the port from which they had sailed. The 22nd December is celebrated as



Pilgrim Fathers pray on landing

'Forefathers' Day" in memory of them

PIPE LINES. To carry water and oil over great distances, particularly over rough and hilly country, it is more economical to use large steel pipes than to build a railway and carry the liquid in tank cars. At intervals along the pipeline are built pumping stations to speed up the flow.

Pipelines are also used in the U.S.A. to carry gas from the oil wells to cities and factories for light and power.

PIRATES were high seas robbers sailing an armed vessel without legal commission. They waylaid and robbed any vessel that looked a likely prize. Piracy is as old as sea-trading. The great Roman, Julius Caesar, was once captured by pirates.

The most dreaded pirates of the Middle Ages were the Barbary

pirates, with their headquarters at Algiers and neighbouring ports. They were Moslems, and delighted to capture Christian seamen, whom they sold as slaves.

The riches of the Spanish West Indies attracted pirates of all nations. They lay in wait off the Portuguese and Spanish coasts, and often snatched a prize from under the guns of the armed galleons.

During the 18th century, pirates had lairs among the rocks and shoals of the Bahama Islands.

Pirates lurked in the China Seas as late as the present century, but swift steamships, and more recently the use of wireless, have practically driven them off the seas.

PITCH is the hard residue from the distillation of coal tar or **PETROLEUM**, used for paint, road surfaces, insulation, the sealing of ships' bottoms, and many other purposes.

Pitch, in music, is the height or depth of a note. See **VIBRATION**.

PITCHBLLENDE is a black ore valuable for its content of radioactive elements, of which **URANIUM** and **RADIUM** are the best known. See **CURIE**.

PITT, William, the Elder (1708-1778), was the son of a Cornish squire. He entered Parliament in 1735, but it was not until 1756 that he became Secretary of State and Leader of the House of Commons. This great statesman wanted to revive the glory of Britain which was then somewhat dimmed. In Canada Britain had lost forts, in India Calcutta had been lost to the young Suraj-ud-Dowlah, in Europe the island of Minorca had been lost, and British troops had been defeated in Germany. Pitt decided to keep the French busy in Europe while the British recovered power in India and America. He made raids on the French coast, and gave

money subsidies to Frederick the Great of Prussia to help him carry on war with France. British troops were also kept in Hanover.

In 1757 CLIVE won the Battle of Plassey, and checked French influence in India. In 1759 the troops in Hanover won the Battle of Minden, the French fleet was defeated at Quiberon Bay, and in Canada Wolfe took Quebec.

Pitt was made Earl of Chatham. His last speech in the House of Lords was about the American colonists, who were fighting for their INDEPENDENCE. He collapsed while speaking, and died soon afterwards.

PITT, William, the Younger (1759-1806), was the son of the Earl of Chatham. He entered Parliament in 1781. Before he was twenty-five, Pitt became Lord of the Treasury and Chancellor of the Exchequer.

During Pitt's first term as Prime Minister (1783-1801) the India Bill was passed, regulating the Government of India, and remained in force until the Indian Mutiny (1857). He also brought about the union of the Irish Parliament with that of Great Britain. His efforts for parliamentary reform failed. When after the French Revolution France declared war on Britain, Pitt's policy was to restrain the power of France and maintain British supremacy at sea.

In 1801 Pitt resigned office, having failed to obtain the repeal of the old Acts against Roman Catholics. In 1804 he returned to office, and made an alliance with Russia and Austria. When the news of Napoleon's victory at Austerlitz reached Pitt, he cried, "Roll up the map of Europe! It will not be wanted these ten years." He died a few days later, only forty-eight years of age.

PLAINSONG See CHURCH MUSIC

PLANET, a large solid body revolving round the sun. The principal planets are Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune, Pluto. Jupiter, the largest, has eleven moons and a diameter eleven times that of the earth. There are also thousands of minor planets, having a diameter of less than four hundred miles.

PLANT FOODS Plants take part of their food from the air and part from the SOIL. Gases of various kinds are taken from the air, and mineral salts and water from the soil, through the roots. The chief plant foods are nitrogen, potash and phosphorus. See FERTILIZERS, HUMUS, MANURING.

PLASTICS are materials which can be moulded by heat and pressure into desired shapes and which on cooling retain their new shape and become rigid. Of course, steel, clay, glass, plaster of paris, etc., are plastic, but the term "plastics" is reserved for the new raw materials, such as synthetic resins, which the scientist has evolved.

One plastic is celluloid, made from cellulose nitrate and camphor. Bakelite is made from carbolic acid and formalin. There are several plastics made from casein, the protein of skimmed milk. Then there are the transparent plastics used for windscreens and lenses.

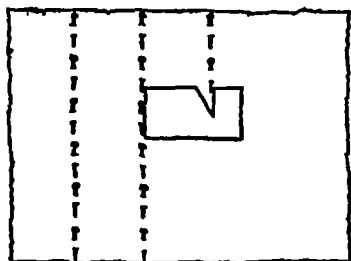
Plastics are usually light, easy to mould, and non-conductors of electricity.

PLATEAU, an elevated mass of land with a fairly level surface, often fringed by mountains which descend steeply to the lowlands.

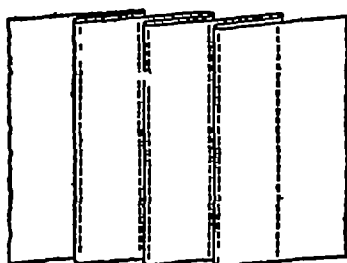
PLATINUM is a metallic ELEMENT which has a very high melting point and density, and is not affected by most chemical agents.

PLATO (428–347 B C), Greek philosopher, conceived this material world as being an imperfect imitation of a world of ideas, which alone are permanent, the idea of the good being its central point. Thus virtue is the understanding of the good, and the attempt to realize it. Plato's principal dialogues were the *Symposium* and the *Republic*.

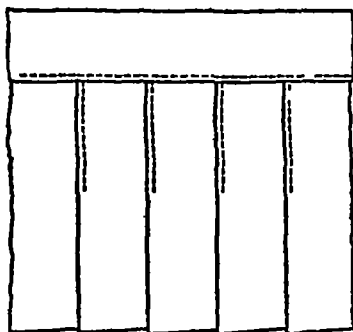
PLEATS in needlework take three times as much material as their width. To calculate the width of material required when cutting out, to the width of the garment add twice the width of each pleat. Using a marker, mark off pleats with rows



1 MARKING OFF PLEATS WITH PINS



2 PLEATS FOLDED AND TACKED

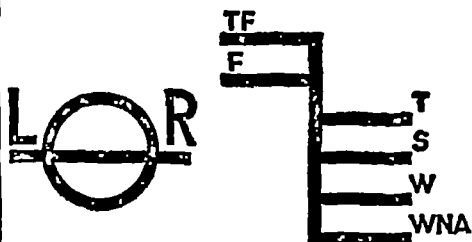


3 PLEATS SET INTO BAND & STITCHED
Steps in making pleats

of pins (see 1). Fold the pleats over and tack securely down both edges before setting them into the band (see 2). Turn the edge of the band in on the wrong side, place it over the pleats, tack carefully and machine. Pleats are usually machined a little way down to keep them neat (see 3).

PLEBISCITE, a direct vote of all the electors in a state or district on some important question affecting the national future of the electors.

PLIMSOLL LINE. To show the limit of the amount of cargo that can be taken aboard a vessel without endangering it, lines are required to be painted on the sides of every sea-going ship. The ship



Plimsoll Line on the sides of ships the various levels refer to the water in which the ship will sail (TF) Tropical Fresh Water, (F) Fresh Water, (T) Tropical, (S) Summer, (W) Winter, (WNA) Winter North Atlantic, (LR) Lloyd's Register

can be loaded until these lines are level with the water but not below the water.

The safe depth to which a ship may be loaded varies with the water it sails in and its temperature.

This safeguard was introduced by Samuel Plimsoll (1824–1898), after whom the line is named. See also **ARCHIMEDES**.

PLUTARCH (1st century A D), Greek author of the parallel *Lives* of twenty-three Greeks and twenty-three Romans, arranged in pairs. North translated them into English.

from French, in 1579, in which form they provided Shakespeare with the plots of several plays including *Julius Caesar* and *Antony and Cleopatra*

PLUTO, in CLASSICAL MYTHOLOGY, is the god of the underworld, **HADES**

POET LAUREATE, is the title given to a poet who is appointed a salaried officer of the royal household **DRYDEN** was the first officially to hold the title, although earlier, **Ben JONSON** had carried out the duties of the office He was expected to produce appropriate poems on public events, but such writing-to-order is no longer required of them The present Poet Laureate is **John MASEFIELD**

POETRY is the expression in rhythmic language of thought and feeling A distinction is often made between verse and poetry, verse being language that rhymes, while poetry is the expression of thoughts in language capable of moving the feelings of the reader so that he feels as the poet See **PROSODY**

Poetry takes different forms, of which some have distinctive names *Lyric poetry* is the general name for short or fairly short pieces The name denotes something to be sung, but, since Elizabethan times, lyric poetry has had no necessary connexion with music A lyric can nowadays be defined as the expression in poetry of an experience very personal and moving to the poet

Special forms of the lyric are the *ode*, the *elegy* and the *sonnet* The ode is written by a poet who feels he must do homage, as it were, to his subject and glorify it, as in Tennyson's "Ode on the Death of the Duke of Wellington" and Keats' "Ode on a Grecian Urn" The elegy carries the poet's feeling of personal loss occasioned by someone's death The sonnet must conform to special rules of length—fourteen lines—

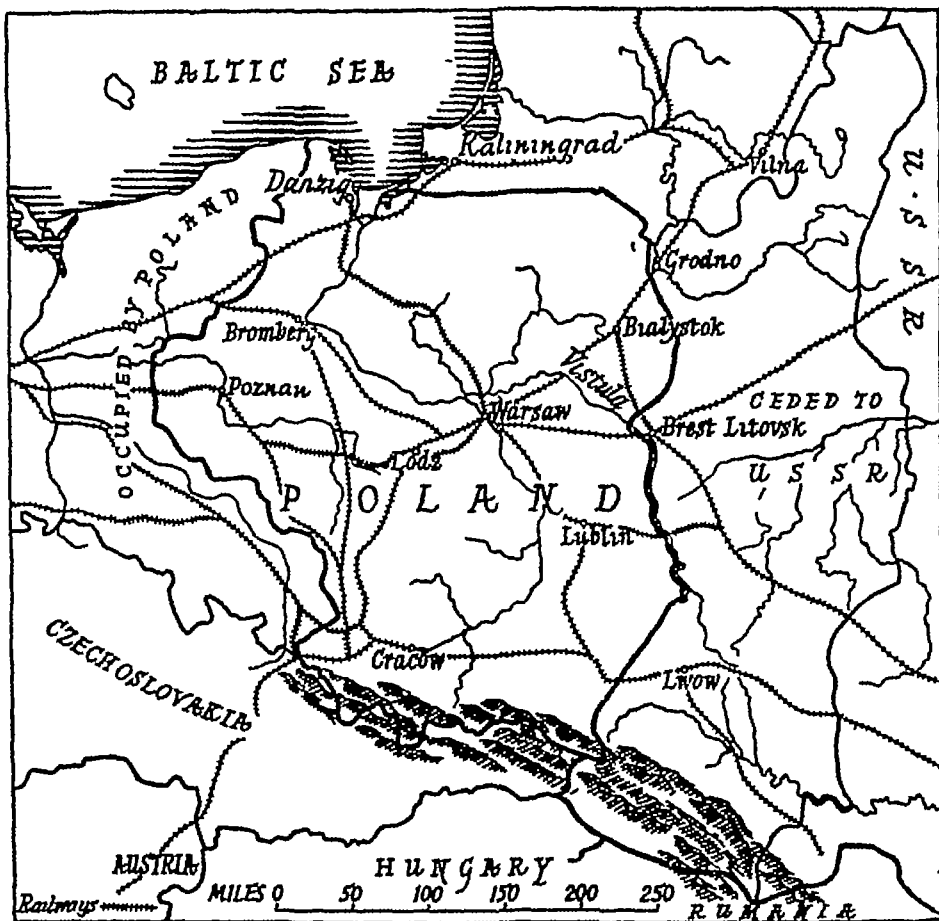
and the metre should be of a particular kind Shakespeare and Milton used the two chief kinds of sonnet found in English, Shakespeare used the rhyming scheme *abab, cdcd, efef, gg*, Milton the Petrarchan scheme *abbaabba, cdecde*

POISON is any substance which injures the body tissues (possibly causing death) when swallowed or applied externally Poisons may be in gas, liquid or solid form Strong **ACIDS**, or **ALKALINE** fluids like ammonia, may burn the skin, as do some poison gases When poisonous substances such as bad food have been swallowed, an emetic is often necessary to make the patient sick and remove the poison, but this should not be given without expert advice

POLAND lies on the great plain north of the Carpathian Mountains On the plains farmland alternates with forest, heath and marshes Oilfields, salt mines and coal mines in the south support a manufacturing region The capital is Warsaw on the banks of the Vistula

History During the Middle Ages Poland was an important state But there was no hereditary royal family, and when the throne fell vacant, a new king had to be elected, and this led to disturbances In the 18th century Russia, Prussia and Austria took advantage of Poland's weakness, and annexed parts of the country A new partition took place in 1795 when Russia took what she wanted, and left Austria and Prussia to squabble over the rest

At the close of the First World War, an independent Polish Republic was proclaimed As Poland had no sea coast, a narrow strip of land was marked off through East Prussia, leading to the sea This "Polish Corridor," as it was called, was a constant source of dispute between Poland and Germany



Map of Poland, showing new boundaries as a result of the war

In March, 1939, Britain and France entered into an agreement with Poland to protect the country from German invasion. The Germans, however, invaded Poland on 1st September, 1939, and this and other aggressions led to the Second World War. On 17th September the Russians invaded the country, and Germany and the U.S.S.R. issued a joint declaration that the Polish Republic had ceased to exist, and its territory was divided between Germany and the U.S.S.R. When Russia herself was invaded by Germany in 1941 she signed a treaty of friendship with the "Free Polish Government." After the defeat of Germany in 1945, Poland regained her freedom, lost and

gained some territory, and made a pact of friendship with her great Slav neighbour, Soviet Russia.

POLECAT. See FLESH-EATING MAMMALS

POLES. The *Geographical Poles* are the ends of the axis about which the EARTH rotates every day. One end is the North Pole, the other end is the South Pole.

The *Magnetic Poles* are points on the earth's surface where compass needles point vertically. See MAGNETISM OF THE EARTH. The Magnetic North Pole is in the extreme north of Canada, the Magnetic South Pole in the Antarctic. The magnetic poles are not constant in position but move steadily in an oval path over some hundreds of years.

Navigators using the magnetic COMPASS must allow for the difference between the True North Pole and the Magnetic North Pole See MAGNET AND MAGNETISM

POLICE, an organization for the preservation of order and the enforcement of the law The Metropolitan Police Force, with its present headquarters at Scotland Yard, was formed by Sir Robert Peel in 1829 and is under the control of the Home Office it has a uniformed branch, whose task it is to prevent crime, and a plain-clothes branch (the Criminal Investigation Department), to track down and arrest criminals The River Thames Police patrol this most important waterway The City of London Police look after the square mile of the City of London and are responsible to the Lord Mayor In the provinces the police are adminis-

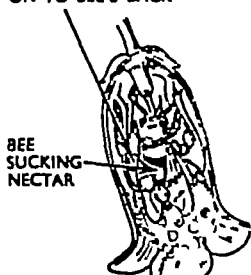


River Thames Police on patrol

tered by watch committees of the city and borough councils and by standing joint committees of the county councils

POLLINATION is the process in which male cells (or pollen grains) are carried from stamens to stigmas of the same flower (self-pollination) or to stigmas of another flower of the same kind (cross-pollination) When pollen from

STAMEN FREEING POLLEN
ON TO BEE'S BACK



BEE
SUCKING
NECTAR

SECTION OF FOXGLOVE
TO SHOW BEE WITHIN



BUMBLE BEE
AT PINK CLOVER

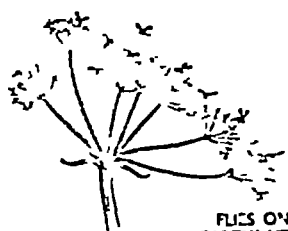


BEE AT
SNAPDRAGON

HAWKMOOTH
AT HONEYSUCKLE



HEAD OF MOTH
WITH TONGUE
CURLED UP



FLIES ON
EARTHNUT

Living creatures pollinating flowers in their search for food

stamens touches the stigma it adheres and passes down the hollow tube of the style into the ovary where it makes the seeds fertile. See FERTILIZATION, and illustration under FLOWER. Most flowers ensure cross-pollination by ripening their stamens first.

Plants pollinated by wind have inconspicuous petals — sometimes none at all, and no scent or bright colours. They either flower early, like hazel and elm, or have flower heads standing up above the leaves, as in grasses and nettles.

Flowers pollinated by insects have brilliantly coloured petals and scents to attract insects, which visit them to suck nectar or eat pollen. As they do so, pollen adheres to their backs or legs and they carry it unconsciously from one flower to another. Some wide, flat flowers are pollinated by short-tongued flies, deeper types by hive and bumble bees or wasps, and those with long tubes, like honeysuckle, by long-tongued moths.

POLO is a game played on polo ponies on a ground about 300 yards long by 200 yards wide, by two teams of four players each, known as Number 1, 2, 3, and 4. The object of the game is to score most goals, a goal being scored when the $4\frac{1}{2}$ ounce white ball, 3 inches in diameter, is driven through the opponents' goal which is 8 yards wide. The sticks for driving the ball are 4 feet 6 inches long with a cross piece at the end. Number 1 has to intercept the back player of the opposing team, Number 2 plays forward, and while Number 3 occupies an intermediate position, Number 4 is the back player. As the players pass the ball to one another, these positions are constantly changed. Two umpires are often necessary and penalties are awarded for infringements of the

rules. A game consists of seven periods of eight minutes each, the period being known as a "chukker." There is a three-minute interval between one chukker and the next, when ponies are changed.

POLONAISE, a stately dance of Poland, usually in three-four time, the rhythm of which has formed the basis of piano pieces by CHOPIN. It has also been used by many other composers.

POLYNESIA, the small islands of the central Pacific, including the Sandwich, Society and Marquesas Islands, Tonga, Samoa and many other islands. Some of the islands were formerly VOLCANOES, others are made of CORAL. The Maoris of New Zealand speak a Polynesian language.

POLYPHEMUS. See CYCLOPS.

POLYTECHNIC, an institution where instruction is given mainly in technical and commercial subjects in day and evening classes.

POMPEII was a fashionable Roman town, at the foot of Mount Vesuvius. In A.D. 63 an earthquake destroyed a large part of the town. The people were still engaged in rebuilding when a second disaster occurred in A.D. 79. Vesuvius burst into eruption, and poured cinders, stones and hot ashes on to the town. Streets were blocked, houses destroyed, and the whole city completely buried.

Now the greater part of the town has been uncovered, including the great amphitheatre to seat 20,000 people. The houses and shops, still containing household goods and furniture, give a good idea of life in a Roman town nearly 2,000 years ago.

PONTIUS PILATE was a Roman official in charge of Judaea, which in Christ's lifetime was part of the Roman Empire. It was Pilate who at the insistence of Christ's religious

enemies the orthodox priests, sanctioned His being put to death by the very cruel Roman way of crucifixion

POPE, title of the Bishop of Rome, head of the Roman Catholic Church He is elected by the cardinals, and lives in the Vatican, a palatial official residence in the area known as the Vatican State, in the city of Rome

POPE, Alexander (1688-1744), was the leading English poet of the early 18th century His first important poem, *The Essay on Criticism*, brought him into literary society *The Rape of the Lock* deals with a minor scandal in society and burlesques the pompous style of some writers of his time In 1719 Pope went to live at Twickenham, the place closely associated with him His malicious wit is shown in his satires, *Imitations of Horace* and the *Epistle to Dr Arbuthnot*, which did not spare his intimate friends, while *The Dunciad* is a brilliant attack on the minor poets of the time, now forgotten except as figures in the satire *The Essay on Man* is a philosophical work

Pope was a master of the heroic couplet (see **PROSODY**), which he used with devastating effect in his satire

PORCUPINE. See **RODENT**

PORTRAITURE, the art of drawing or painting the likeness of a person Yet a portrait is more than a mere likeness of the outside appearance of a person If we look at portraits by great artists, such as Rembrandt's portraits of himself, the "Doge of Venice" by Giovanni Bellini, or the "Mona Lisa" by Leonardo da Vinci, we see not only the features of the person recorded, but character and personality as well

PORTUGAL extends along the west coast of the Iberian Peninsula



Pope, satirical poet

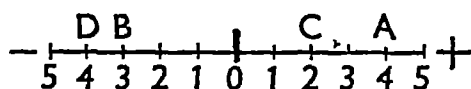
In the north, port wine made from grapes grown in the Douro Valley is exported from Oporto Lisbon, the capital, lies near the mouth of the River Tagus in a region where wheat, barley and cork are produced Fish, especially sardines, are canned and dried for export In the extreme south cultivation depends on **IRRIGATION** Portugal controls wide territories in South Africa, it also possesses several Atlantic island groups the Azores export oranges and pineapples, and are a stage on the Lisbon-North America air route, the Madeira Islands, famed for their warm and equable climate, produce mainly wine and fruit, the Cape Verde Islands are less highly developed but coffee, castor oil seeds and fruit are exported to Lisbon Timor in the East Indies is partly Portuguese See map of **IBERIAN PENINSULA**

POSEIDON is the Greek name for **NEPTUNE**

POSITIVE and **NEGATIVE**.

In measuring we start from a zero point, which we usually mark 0 Let us suppose positive quantities are measured to the right and negative quantities to the left of

this zero point Say we want $4 - 7 + 5 - 6$ We start at 0 and measure 4 to the right, this takes us to A



From A we measure -7 , that is 7 to the left, this takes us to B, which is -3 From B we measure 5 to the right, this takes us to C, which is $+2$ From C we measure -6 , that is 6 to the left, this takes us to D, which is -4

No matter in what order we take $4, -7, 5$, and -6 we always get the same end result Thus $-7 - 6$ takes us to -13 , $+5$ takes us to -8 , and $+4$ to -4 , the same end point as before

We sometimes measure up and down, positive quantities up from the zero point and negative quantities down

In adding a number of quantities, some $+$ and some $-$, it is often convenient to add the two sets separately and then to find the difference

$$(a) \ 16 - 7 - 8 + 14 + 6 - 13 + 18 \\ = (16 + 14 + 6 + 18) - (7 + 8 + 13) \\ = +54 - 28 = +26$$

$$(b) \ 14 + 6 - 19 - 34 + 7 - 41 \\ = (14 + 6 + 7) - (19 + 34 + 41) \\ = +27 - 94 = -67$$

There is another important point about $+$ and $-$ Whatever $+$ means, $-$ always means the opposite $(+4) \times (+3) = +12$, so $(+4) \times (-3) = -12$ $(-4) \times (+3) = -12$, so $(-4) \times (-3) = +12$ This gives us the following rule when we multiply, like signs give $+$, unlike signs give $-$

$$(+x) \times (+y) = +xy$$

$$(-x) \times (-y) = +xy$$

$$(-x) \times (+y) = -xy$$

$$(+x) \times (-y) = -xy$$

$$+x \times +x = x^2, -x \times -x = x^2$$

Thus x^2 is the square of both $+x$ and $-x$ So the square root of x^2 is either $+x$ or $-x$ We write this $\sqrt{x^2} = \pm x$

When a minus sign comes before brackets, it changes the sign of everything within the brackets

$$-(a - b + c - d) = -a + b - c + d$$

$$-2(x + y - z) = -2x - 2y + 2z$$

$$-ab(a^2 - 2ab + b^2) = -a^3b + 2a^2b^2 - ab^3$$

POSTAGE STAMPS. Stuck-on stamps to show that the correct amount of postage has been paid are now used in most countries in the world For the development of the post, see **POSTAL SERVICES** See also the article on **STAMP COLLECTING**, an interesting hobby for all

POSTAL ORDER, an order to a post office to pay the person named the amount stated You can buy such an order at any post office and you can cash it at any post office If, for example, you wish to send $\pounds 1$ to your brother, who is away on holiday and has asked for money, you can go to any post office and buy a postal order for $\pounds 1$ It will cost a few pence more than $\pounds 1$, but you are paying a little extra for the service the post office does you Before sending it, you fill in his name and, if possible, the address of the post office where your brother can cash the postal order When he receives it, he goes to the post office named and draws the $\pounds 1$ after signing his name as a receipt Because there are post offices in nearly every town and village, this is a very convenient way of sending money

POSTAL SERVICES The first bearers of messages were couriers who rode on horseback from London to the chief towns of England and Scotland carrying information to and from the King and the

Government Under Henry VIII an effort was made to reduce the time taken by couriers in performing their duties by arranging that they could change their horses at certain stages of their journeys instead of having to wait until they were rested. Fixed charges were made for the use of these horses and the men who provided them were called postmasters and the horses were described as post-horses.

This was the beginning of postal arrangements, for later regular messengers replaced the king's couriers, and those who wanted to use these post-boys, as they were called, could do so at a fixed fee. A Postmaster-General was appointed to organize the system and when James I became king the posts were speeded up. The charge for each letter was twopence per mile and the fee had to be paid before the letter was sent.

An Englishman named Witherings suggested that letters for a particular district should be collected in a bag which was addressed to the postmaster of the place to which it was to be sent. That postmaster then posted a notice giving the names of people for whom he had letters, and they called for them. People had to deliver their letters to the receiving office in their city and pay in advance for their conveyance. This became twopence for a distance up to eighty miles, fourpence up to a hundred and forty miles, and sixpence for a greater distance, while a letter to Scotland cost eightpence. There was, therefore, a substantial reduction in postal charges. Gradually such improvements were effected that post-horses and post-boys covered every important road while taking letters, valuables and small parcels. Frequently highway-

men robbed the boys, so it was decided to send the post in a carriage with an armed guard on the box. This change was effected in 1784 and did much to popularize the post.

In 1840 postage stamps were issued and penny postage for letters was introduced by Sir Rowland Hill. Mails then began to be sent by rail in special vans known as mail vans. Letters can now be despatched by express post or air mail as well as in the ordinary way. See **STAMP COLLECTING**.

A still speedier way of sending messages is by telegraph or cablegram, while one of the most modern means of communication is the **TELEPHONE** which was invented by Edison and Bell, and innumerable business and social affairs are conducted by its use. See **TELEGRAPHY** and **TELEPRINTER**.

The latest means of communication to be invented is that of **WIRELESS** by means of it messages can be transmitted all over the world in a very short space of time.

POTASH is the salt, potassium carbonate, which can be dissolved out of wood ash with water. It is a valuable fertilizer and is also used in making soft soap.

POTASSIUM is a soft metallic **ELEMENT** which combines violently with water, releasing hydrogen and forming caustic potash.

The chief potassium **COMPOUNDS** in use are potassium bromide, used as a sedative, potassium chlorate which gives off oxygen freely when heated with manganese dioxide, and which is also used in matches, potassium cyanide, a violent poison used for killing wasps in their nests, potassium nitrate or saltpetre, used in fireworks and gunpowder.

POTATO PRINTING is a quick way of printing an all-over design

on paper or cloth. Choose a medium-sized uncooked potato and cut it in half, cut it down again till you have a raised cube with a square surface of size $\frac{1}{2}$ inch to 1 inch long. With a sharp penknife cut away bits of the surface so that a pattern is formed on the top (a cross or a right-angle is a simple pattern to begin with). The part you have left standing up will show on the paper.

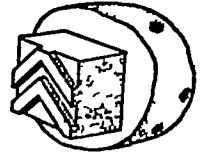
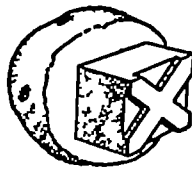
To print on paper, take a piece of paper which has not too shiny a surface, paint over your pattern on the potato cube with thickish paint and press it on to the paper. This gives your first print and by repeating the process alongside it you can make the pattern more elaborate. (It is best to remove excess moisture from the potato cube by pressing the potato on a piece of paper before painting over the pattern.)

Experiments will soon give you some designs. If you do not cut your first pattern too deeply you can use the same potato cube several times by slicing off the first pattern and cutting another.

Remember that the potato will shrivel up if you keep it, so do all printing with the potato the day you cut it.

Water-colour paints will print very well on paper, but for cloth you will need oil or stencil paints. You can buy these in tubes.

To print on cloth, stretch your material out with drawing pins over a pad of newspaper or blotting paper. Mix your paint with a very little turpentine on a piece of glass or a glazed surface. Press your potato on to the paint and try the



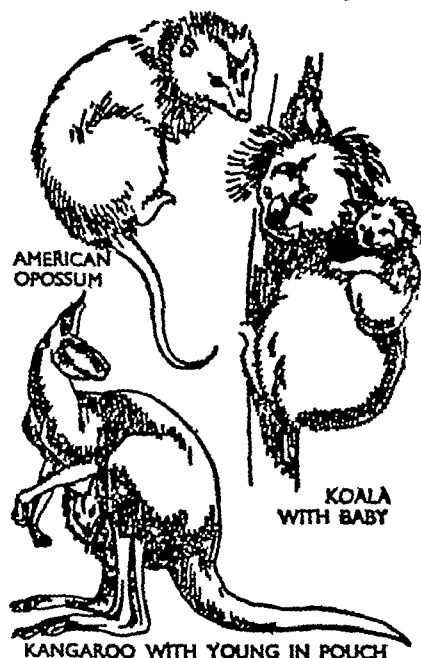
Designs you can use in potato printing

effect on an odd piece of cloth. If the paint is just right print the material as quickly as possible. Some people rule faint lines in pencil first to guide them when repeating the pattern, but if you have practised on paper first this may not be necessary. You can print on organdie, linen, casement cloth, or any material with a smooth, even weave. Oil paints will not wash out and you can use the printed material for scarves, handkerchiefs, collars, cushions or curtains.

POTTING is the process of planting cuttings from old plants in small garden pots in order to produce new plants. The hole at the bottom of each pot should be covered with broken crock and the pot filled to within an inch of the brim with fine soil or potting compost. Press the soil down with the fingers around the cutting so as to secure it firmly. **SEEDLINGS** grown in boxes are usually potted at a certain stage of their growth, first into small pots and then into larger ones as the growth increases. See **COMPOST, PROPAGATION**.

POUCHED MAMMALS include the kangaroos, wallabies, koalas, wombats, bandicoots and phalangers of Australia, and the opossums of America. These primitive mammals have survived in Australia, where they evolved many forms, in

the absence of competition with higher MAMMALS, none of which appeared there until brought by man Running, jumping, tree-living, burrowing and aquatic types are found, some eating flesh and some plants After birth the young animals, which are often less than an inch long, live for a time in the mother's pouch, where they suck



AMERICAN
OPOSSUM

KOALA
WITH BABY

KANGAROO WITH YOUNG IN POUCH

Three common pouched mammals

milk Young kangaroos often return to the mother's pouch for shelter when they are so large that their legs hang out

Kangaroos have huge hind legs for leaping, and the thick tail is used for balance and support

Koalas, the "native bears," live in eucalyptus trees, feeding on the leaves Their numbers have been reduced so badly by fur traders that they are now protected by law from being killed

The young of many pouched mammals are often carried along on mother's back

POWERS AND INDICES

3^2 (three squared) means $3 \times 3 = 9$
 3^3 (three cubed) means $3 \times 3 \times 3 = 27$ 3^4 (three to the power 4) means $3 \times 3 \times 3 \times 3 = 81$, and so on $3^2, 3^3, 3^4, 3^5$, etc., are called powers of 3 The small number which shows the number of 3's to be multiplied together is called the *index* of the power (plural *indices*) We can have powers of any number or fraction $(\frac{1}{2})^2 = \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} = \frac{1}{8}$, $(\frac{2}{3})^4 = \frac{2}{3} \times \frac{2}{3} \times \frac{2}{3} \times \frac{2}{3} = \frac{16}{81}$, i.e. $(\frac{2}{3})^4 = \frac{2^4}{3^4} = \frac{16}{81}$

We use indices to multiply or divide powers of the same number $7^2 \times 7^3 = (7 \times 7) \times (7 \times 7 \times 7) = 7^{2+3} = 7^5$ Thus, to multiply powers of the same number we add the indices

$$x^a \times x^b \times x^c = x^{a+b+c}$$

To divide powers of the same number, we subtract the index of the divisor

$$8^5 \div 8^2 = \frac{8 \times 8 \times 8 \times 8 \times 8}{8 \times 8}$$

$$= 8^{5-2} = 8^3$$

Following these rules, we can find meanings for A^0 , A^{-n} , and $A^{\frac{1}{n}}$, where A stands for any number

(a) $9^2 \div 9^2 = 9^{2-2} = 9^0$ As $9^2 \div 9^2 = 1$, so 9^0 stands for 1 Any number to the power 0 equals 1 In general $A^0 = 1$ (b) $10^3 \div 10^5 = 10^{3-5} = 10^{-2}$ But $10^3 \div 10^5 = \frac{10 \times 10}{10 \times 10 \times 10 \times 10 \times 10} = \frac{1}{10^2}$

so 10^{-2} stands for $\frac{1}{10^2}$ In general

$A^{-n} = \frac{1}{A^n}$ (c) $6^{\frac{1}{2}} = 6^{\frac{1}{2} + \frac{1}{2} + \frac{1}{2}} = (6^{\frac{1}{2}})^3$, so $6^{\frac{1}{2}}$ stands for the cube of the fourth root of 6 $5^{\frac{1}{3}}$ stands for the square of the cube root of 5, and so on In general we may write thus $A^{\frac{1}{n}} = (\sqrt[n]{A})^n$

$16^{\frac{1}{2}} \times 16^{\frac{1}{2}} = 16^1$, or simply 16 But the square root of 16 multiplied by the square root of 16 ($\sqrt{16} \times \sqrt{16}$) is 16 also So $16^{\frac{1}{2}}$ stands for



Press gang seizing an unwilling recruit for the Navy

$\sqrt[4]{16}$ (the square root of 16) In general $\sqrt[n]{x} = \sqrt[n]{x}$, $x_1 = \sqrt[n]{x}$ and so on See LOGARITHMS and ROOTS
PRAWN. See CRUSTACEANS

PRAYER in the Christian view means talking with God so that we can find out what He wants us to do It does not merely mean asking God to give us what we want, but is the opening of our hearts so that He can make us better and stronger to do His will

PRAYER BOOK (correctly *Book of Common Prayer*) contains all the services of the CHURCH OF ENGLAND It was first issued in 1549, several times revised, and completed in 1662

PREDICATE. See GRAMMAR

PREFIX, an element placed before a word, and joined to it to modify its meaning, as in "fashion" —"re-fashion"

PRELUDE, originally the opening piece of a SUITE of music, or an

introduction to a FUGUE, the name was then applied to the introductory music to an act of an opera, and later to independent instrumental pieces, often in ternary FORM

PREPOSITION. See GRAMMAR

PRESBYTERIANISM, a Christian denomination which started at the REFORMATION through the work of CALVIN and KNOX Presbyterians have no bishops, but have instead presbyters (another word for priests) and elected lay elders They are governed by a General Assembly, and by local synods The Church of Scotland is Presbyterian

PRESS. The Press comprises all printed matter such as newspapers, periodicals, pamphlets, etc By the freedom of the Press is meant the right to print and publish without CENSORSHIP See JOURNALISM

PRESS GANG, a naval party sent ashore to impress men for the Navy—carry them off for service

against their will This method of gaining Navy recruits was at one time common in Britain, especially during the wars against France in the 18th and early 19th centuries when voluntary enlistment did not produce the numbers necessary to man all the ships Improvements in the conditions of service rendered this method unnecessary and service in the Navy soon became popular

PRESSING See **IRONS** AND **IRONING**

PRESS STUDS, TO SEW ON
The stud of a press fastener should be sewn on that part of the material which will be on top, the flat half on the lower layer Place the stud in position, work four **BUTTONHOLE STITCHES** into each hole, slipping the needle along the material to the position for working the next, and so on Rub a little tailors' chalk on the stud, press it down on the material beneath and you have the exact position for the flat half Sew thus on in the same way as the stud

PRIEST. In the Old Testament, a priest did the sacred work of offering sacrifice In the early Church, Christian ministers were called "presbyters," which has been shortened to "priests" The second order of **CLERGY** are the priests

PRIME MINISTER or **PREMIER** King **GEORGE I** did not speak English and, when his ministers met, it was left to one of them to preside He became the Chief, or Prime, Minister This custom was continued and the office of Prime Minister became an official one Sir Robert Walpole was the first to exercise the functions of Premier, and during his tenure of office government by the *Cabinet*, a group of the principal ministers, developed See also **PARLIAMENT** and **HOUSE OF COMMONS**

PRINCE CONSORT, a title granted to the husband of a queen who succeeds to the Throne in her own right Thus, this title was conferred upon Albert of Saxe-Coburg-Gotha after his marriage to Queen **VICTORIA**

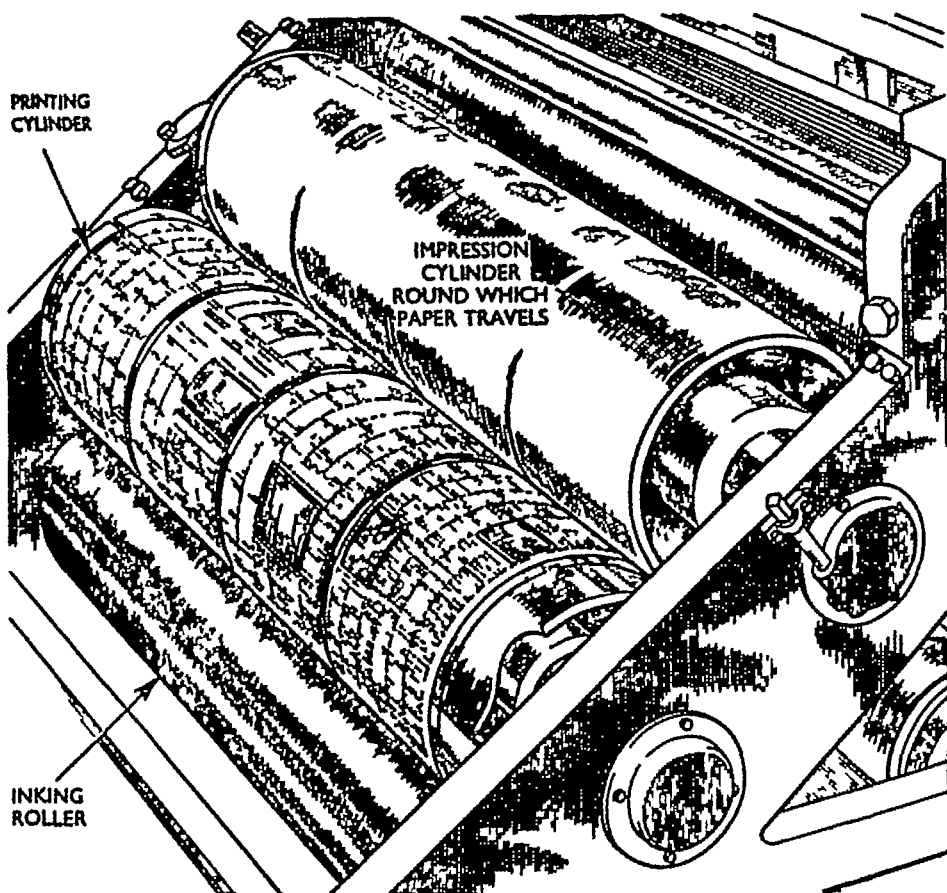
PRINCE OF WALES, title conferred upon the eldest son of the reigning British sovereign It was first conferred by **EDWARD I** upon his new-born son, afterwards Edward II

The Prince of Wales' badge carries the inscription "Ich dien"—"I serve"

PRINTING as we know it today started in the 15th century with the invention of movable types by Gutenberg Caxton introduced the craft into England The type was built up by hand and fixed in a frame, then inked and the paper pressed on to it Today the pieces of type are set up either by hand or mechanically on a machine with a keyboard somewhat like the keyboard of a typewriter

If a picture or drawing, etc., is to be printed, it is first photographed this negative image is transferred to a metal block, which is placed in acid so that the parts not to appear are eaten away, leaving the printing surface above the level of the surrounding metal Where there are varying degrees of light and shade in a picture, it is photographed through a screen of criss-cross lines which splits up the light and shade into minute dots of varying size, which when printed will give the effect to the eye of the original gradations of tone

For modern high-speed printing the type is set up mechanically, and then a mould is made of the type area including the "blocks" of pictures This mould is rolled into a half-cylinder, and by pouring metal over its surface a curved plate "



Here the words and pictures are printed on to the paper

formed with a reproduction of the type, etc., on its outer surface.

These curved plates are bolted on to an iron cylinder which revolves and prints on the paper fed to it. An impression cylinder keeps the paper in contact with the printing cylinder, and an inking roller keeps the printing cylinder covered with a special quick-drying printing INK

When it is desired, however, to print a coloured picture in colour, the picture has to be photographed on to separate negatives usually four times, not only through the screen each time, but also through coloured filters as well the first filter will give an image registering all the yellows in the picture, the second filter will give a separate

image of all the reds, a third all the blues, and a fourth photographing will register the picture in terms of black. Four metal plates are made corresponding to the images, and treated with acid to eat away the surface not to be printed. Each metal plate is then printed on to the paper with its appropriate ink, the yellow plate with yellow ink, the red plate with red ink, etc. When all four colours have been printed one on top of the other a coloured print with all the colours of the original picture is produced

This method of printing, where the printing surface is above the level of the surrounding metal, is termed letterpress printing. Other forms of printing are gravure printing, where the matter to be

printed is etched down into a copper sheet; and lithography, where the surface to be printed is greasy and holds ink while the non-printing surface is damp and rejects it

PRIORY, a MONASTERY or CONVENT governed by a prior or prioress

PRISM. See MENSURATION

PRODUCER GOODS. See PRODUCTION GOODS

PRODUCTION means the making of goods and giving of services which people want. If a farmer grows milk or meat, corn or wool, he is a producer. If a manufacturer makes boots or bags, tables or tea cups, he is a producer. If a transport firm carries bricks to where they are wanted, that firm is a producer. When a miner digs coal from the earth, he is carrying coal from a place where it is of little use to a place where it is of greater use. He, too, is a producer. When a doctor restores such a human need as health, he is a producer. he supplies services. When a policeman keeps order, when a soldier supplies safety, when a clown creates laughter, when a teacher imparts knowledge, they all are producers: they produce services. For services and goods are complementary.

The unit of production may vary. It may be a one-man business, or a PARTNERSHIP, or a limited liability COMPANY, or even a large combination of firms, a combine. The place of production may also vary. It may be a farm or a mine, a factory or a mill, a ship or a plane, a hospital or a college. If the activity is such that the result satisfies a human need, then such activity is called production. See PRODUCTION GOODS and MANUFACTURER

PRODUCTION GOODS are those goods that help to produce

more. It has been seen that PRODUCTION means the giving of those goods and services that people want. Now people want two kinds of goods. The final consumer wants a pair of boots. Boots are therefore CONSUMPTION GOODS. But the factory owner who made those boots needs machines to make them. Foundries and engineering works will produce those machines. Because machines help to produce the boots, they are known as production goods. A train, a ship, a lorry, are also all production goods, for they help to carry the goods from places where they are not wanted to places where they are. Bread is consumption goods. But the ovens in which the bread is baked are production goods. Frocks are consumption goods, but the sewing machines which were used to make those frocks are production goods. Ultimately, of course, even production goods are consumed or used up. Clearly that will take longer than consumption goods. You flick a match across a box and it is consumed. But it will take far longer for the machine that cut up the wood to make those matches to be consumed. See CONSUMPTION.

PROFIT AND LOSS. Profit is reckoned in terms of money: it is found by deducting the costs involved in a transaction from the money resulting from the transaction. If, for example, a man manufactures pencils, and sells them for £2,000, and the cost of his raw materials—wood, graphite, paint—is £1,200 and the labour to make them costs £300, then he makes £500 profit. But this is his *gross* profit, and to find the real profit we should have to reckon also his other costs, such as rent, heating, lighting, office expenses, travellers' salaries and commission, transport, interest charges on money borrowed

and so on These charges must be set against the £500 gross profit from the pencils If they come to, say, £100, the *net* profit is £400

This profit is the reward allowed a man by society for his enterprise and productive capacity (see PRODUCTION) and for satisfying the needs of the public If the business were a limited COMPANY, the profits would be distributed among the shareholders according to the SHARES held

If the money resulting from a transaction is less than the costs entailed, then there is no profit and the result is a loss A firm would then have to draw on its reserves of CAPITAL to make up the deficit

PROGRAMME MUSIC is the name given to music which seems to tell a story, or illustrate a poem, or give an impression of a scene, and, in general, has some other claim on the listener besides the beauty of its melody and its form

PRONOUN. See GRAMMAR

PROPAGANDA. This word was originally used of a committee of cardinals who were in charge of foreign missions and whose duty it was to spread the doctrines and teaching of the Church Hence it came to mean using speech, writing, radio, and other means of communication to spread or maintain some principle, belief, or doctrine

As doctrines and principles may be true or false, so propaganda may be true or false

PROPAGATION (of plants) Plants have many different ways of increasing their numbers and of reproducing their kind from one generation to another Wild plants propagate themselves naturally and unaided, but the gardener or farmer can help cultivated plants to become numerous more quickly than they could do by themselves

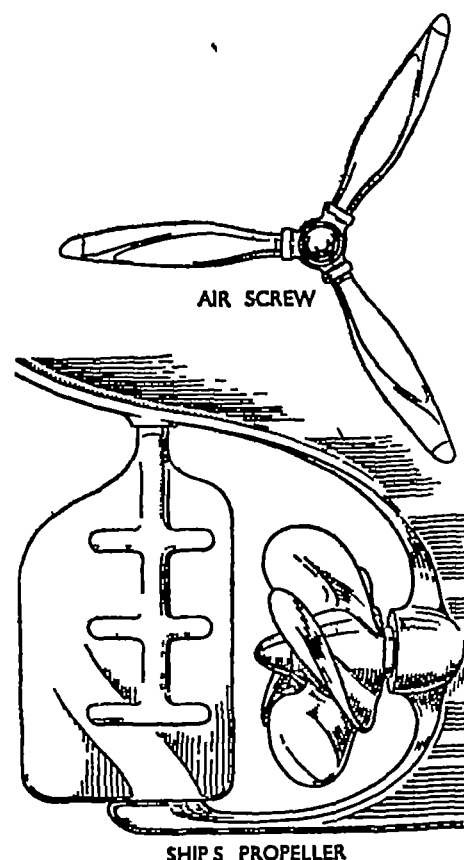
Here are some of the methods by which plants are propagated with human help

(1) SEEDS produced by the parent plants can be sown If sturdy young plants are required the seeds used should be fresh, old seeds do not always germinate

(2) Cuttings or young shoots can be taken from the parent plant and set in firm soil or in pots Geraniums, fuchsias, privet and black and red currants are some of the plants that may be propagated in this way

(3) Roots of PERENNIAL plants such as Michaelmas daisies can be dug up in the autumn, carefully divided and replanted in other parts of the garden

(4) Shoots of carnations and of many bushes and shrubs can be bent downwards and buried in the



Propellers for air and water

soil until they form new roots They are then cut away from the parent plant and a new plant is formed This is called propagation by layering

(5) Tubers — swollen underground stems—of the potato plant can be detached and re-planted to reproduce a new plant

(6) By GRAFTING and BUDDING PROPELLER, a means of propelling ships and aeroplanes in which screw-formed blades turning on a shaft force backwards the fluid in which they are moving and are themselves pushed forward

PROPHET one who foretells future events In the OLD TESTAMENT prophets are those who received a message from God to transmit to others They told men God's plan and called them to repent Most of the great Jewish prophets lived just before and during the EXILE See ELIJAH, ELISHA, ISAIAH and JEREMIAH

PROPORTION See RATIO AND PROPORTION

PROSE is the ordinary form of written or spoken language, without any metrical division

PROSERPINE (Greek Persephone) is, in CLASSICAL MYTHOLOGY, daughter of JUPITER and CERES, goddess of flowers She was carried off by PLUTO, and her mother's grief was such that the earth was allowed to bear no fruit until her daughter was restored to her In allowing her to go, Pluto gave her a pomegranate to eat and having thus eaten in the lower world she was compelled to spend part of the year there and part in the upper world with her mother The myth seems to refer to the absence of flowers from the earth in winter and their return with spring See also ADONIS

PROSODY is the body of technical principles which underlie the

making of verse The chief of these are rhyme and rhythm

Rhyme is the regular repetition of a sound, usually at the end of lines Akin to rhyme is *assonance*, the repetition not of identical sounds, but of sounds closely corresponding one to another, such as "bloom" and "soon"

Rhyme is not absolutely necessary in poetry, but *rhythm* is of first importance Rhythm is produced by the succession of accents or stresses in spoken language, the rhythm of poetry being more pronounced than that of prose Thus

Her eyes were fair, and very fair
Her beauty made me glad

When the accents follow one another regularly they form *metre* Certain arrangements of heavily and lightly stressed syllables within a line are called *feet* Dividing up a line into feet is called *scansion* The following are the commonest feet in English verse (1) Iambus, an unstressed beat followed by a stressed, e.g. *without* (2) Trochee, a stressed beat followed by an unstressed, e.g. *wisdom* (3) Anapaest two unstressed beats followed by a stressed, e.g. *recollect* (4) Dactyl, a stressed beat followed by two unstressed, e.g. *columbine* (5) Spondee, two equally stressed beats, e.g. *farewell*

It must be remembered, however, that feet in a line of poetry may be formed by syllables of different words

When a poet decides to write, he chooses a particular metre Here for example, is one metre

The plough / mān hōme / wārd
plōda / hīs weā / rȳ way
And leāves / the world/ to
dark / nēas and / tō me /
composed of lines containing five

iambic feet But look at the last foot but one of the second line quoted, and you will find a variation There you have a trochaic foot instead of an iambus This is important, because irregularities in poetry are very common Indeed, poetry, if regular for line after line, would be very monotonous and dull Where most of the feet are iambic the metre is iambic, where most are trochaic, the metre is trochaic, and so on

Lines of poetry containing a certain number of feet have special names, of Greek origin A line of three feet is called a trimeter, of four feet, a tetrameter, of five a pentameter, of six, a hexameter Thus the lines quoted above are iambic pentameters

Certain kinds of metre have special names Two successive lines in any metre rhyming with each other form a couplet, if they are also pentameters, they form a heroic couplet For example

Couplet

Slowly, silently, now the moon
Walks the night in her silver
shoon

Heroic Couplet

And still they gazed and still
their wonder grew,
That one small head should carry
all he knew

Pentameters that do not rhyme are called blank verse, the metre mainly used by Shakespeare in his plays

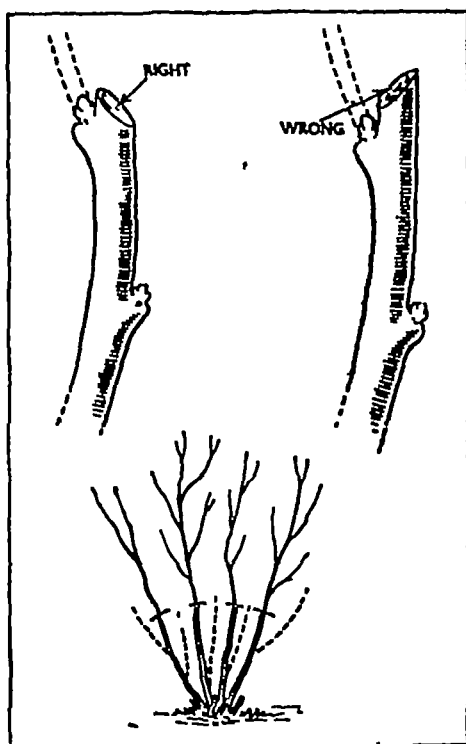
The quality of mercy is not
strained,

It droppeth as the gentle rain
from heaven

Upon the place beneath It is
twice blessed,

It blesseth him that gives and
him that takes

Verse is often divided up into groups of rhyming lines These groups are called stanzas Many



How to prune to encourage growth

poets of this century, however, have been less inclined to follow traditional patterns of rhyme and rhythm, some of their poems rhyme only occasionally, or not at all, or may contain both rhyme and assonance This irregular verse is called free verse

See **IMAGERY** and **POETRY**

PROTECTIONIST. See **FREE TRADE**

PROTECTORATE, a weak or backward country which has come under the protection of a more powerful state

PROTEINS. See **DIET**

PROTESTANT is the name given to members of the various Christian Churches which have arisen as a result of the **REFORMATION** and which do not acknowledge the authority of the Pope

PROTOPLASM, the essential living matter of a **CELL**, it is a substance which has no structure but

is contractile (see AMOEBA), able to breathe, feed, excrete, grow and reproduce itself

PROTOZOA, the name of the lowest group of animals, including the AMOEBA. Many protozoa are important because they cause diseases such as malaria, others because they have formed chalk rock from myriads of their tiny shells. Few can be seen without a microscope

PRUNING in gardening is the cutting off or trimming of the branches of a tree or bush with two objects in view (1) to increase the yield of the tree, (2) to improve the shape. The effect of cutting off part of a tree is to make its growth go in another direction. Skilful pruning directs growth towards the formation of new fruit buds. The cut, made with a knife or pair of secateurs, should always be made just above a bud and sloping downwards away from it. See **FRUIT CULTURE**

PRUSSIC ACID (hydrogen cyanide) is a highly poisonous compound of hydrogen, nitrogen and carbon. It is present in laurel leaves and certain other vegetable materials

PSALM, a sacred song. The Book of Psalms was the hymn book of the Jews. Some of the psalms were written in DAVID's time, others about 800 years later. They have always been widely used in Christian worship

PSYCHE, in CLASSICAL MYTHOLOGY, is a beautiful nymph loved by CUPID

PSYCHOLOGY. While PHYSIOLOGY is concerned with the body, psychology is the study of the mind and the emotions, and, more broadly, of human personality and behaviour

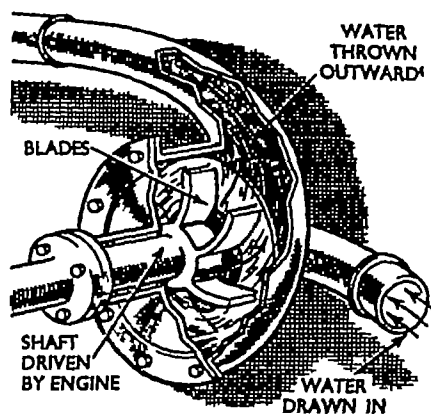
PUBERTY is the period at the end of childhood when male and

female physical features are fully developed. It usually comes later in males than in females

PUERTO RICO, an island in the WEST INDIES. It is U.S. territory, a great proportion of the inhabitants are white and of Spanish descent. The chief products are sugar, coffee, molasses and tobacco. The capital is San Juan. See map of CENTRAL AMERICA

PUMA. See CAT

PUMP, FIRE. This is a pump to deliver large volumes of water at a pressure sufficient to throw a stream to the top of a building



Centrifugal pump

Modern equipment uses a large centrifugal pump driven by a powerful internal combustion engine. Sometimes fire engines discharge a soapy foam which covers the burning material, thus excluding the air, and does not run off. This is particularly useful for fighting fires involving oil or petrol, such as an aeroplane on fire

PUNCTUATION is the use in writing of various signs to indicate the pauses natural in speaking or reading

The full stop (.) marks the end of a sentence—a statement having a meaning complete in itself. *Mary has a pet lamb*

The comma (,) is used to show the briefest of pauses *They stuffed themselves with chocolates, sweets, chewing-gum, tarts ginger beer, and strawberry ice cream. Soon, however, they were sick.*

The semicolon (;) suggests a longer pause than a comma *He planned to go to France, Spain and Italy, then to the Middle East, ultimately to Persia, India and Tibet. This plant is dying, it needs water.*

The colon (:) indicates a longer pause than the semicolon. It is used when your sentence contains two ideas, one of which you want to set off against the other *The enemy are retreating; they must be short of ammunition.* It is also used before a formal quotation *He smiled and began his speech "Ladies and gentlemen, my subject today is 'Animal Photography'."*

Quotation marks or inverted commas (" ") are placed, as in the previous example, at the beginning and end of a quoted statement from book, speech, or conversation.

The question mark (?) is placed after a direct question *Aren't you well?*

The exclamation mark (!) shows a touch of emotion in the speaker *Aren't you tall! Hallo, chaps! For heaven's sake, don't!*

The dash (—) indicates a statement broken off, such as an unfinished threat *"If you do that, I'll—"* Two dashes or brackets show a phrase inserted into the main flow of a sentence *Give him something to eat—poor fellow, he needs it—and tell him to sit down and be quiet.*

Brackets are used when you slip in an additional point of information, e.g. (see Page 744).

PUPPETS. A glove puppet is a doll with a hollow head and arms which are moved by one's fingers.

It is easy to make out of odd pieces of material you will also need some Plasticine, tissue paper, cardboard and paste. The head can be made from an old rolled stocking, but a well-modelled head needs Plasticine. Roll the Plasticine into a ball about the size of your fist. Model the features clearly, making the eyes deeper and the nose and mouth more definite than in a drawing. Cover the model with small pieces of tissue paper, paste the pieces to each other with glue or cold water paste, but do not stick them on to the Plasticine as this has to be removed afterwards. The smaller the pieces of paper are the better, because the features will show up more clearly.

Seven or eight layers of paper pasted on top of each other are needed. When the paper is quite dry and hard, cut this mask in two over the top of the head and through the ears, and scoop out the Plasticine. Roll a thin tube of cardboard around your forefinger. Stick it together firmly, but be sure that it will move easily up and down. Stick newspaper round this, then stick the mask on to the newspaper, joining the cut over the head with more tissue paper and sticking the neck firmly. Paint the features clearly and boldly. The hair may be painted on, or wool stuck on as a wig. If water-colours are used, clear varnish will make them more lasting but may make the complexion rather yellow. Oil paints give a better effect. The puppets must show up from a distance, so paint them as if they were on the stage—a little white paint in the corners of the eyes makes them look more alive.

Every puppet has the same foundation garment which covers up the hand of the actor, as far as the wrist, or a little below. A piece of

material about 9 inches long by 14 inches wide is enough unless the puppet is to represent a giant. This may be joined down the side or only halfway down if the pieces are small.

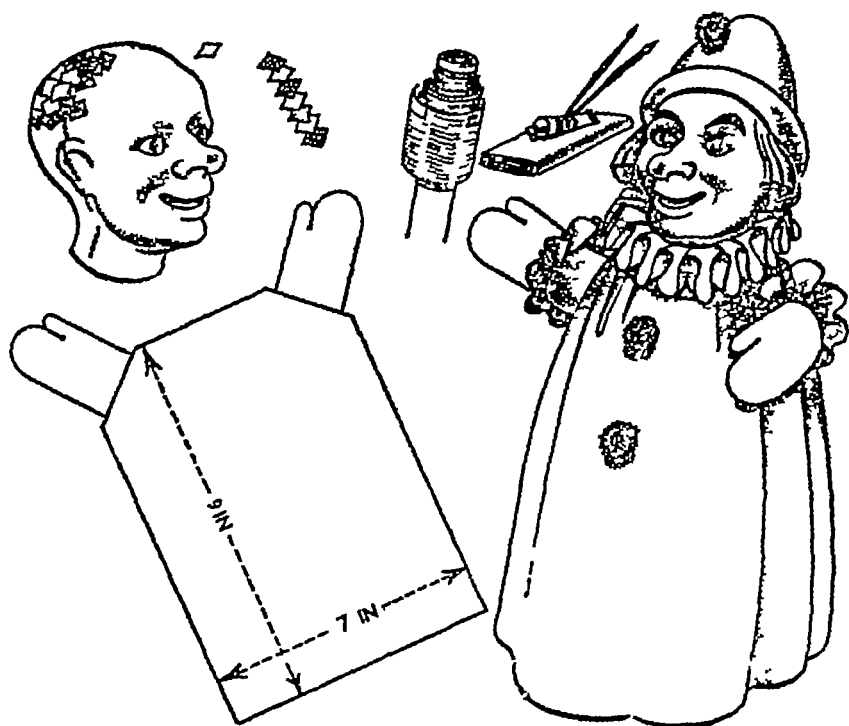
The arms are added near the neck, and sewn straight out from the side or put at an angle as in the diagram.

The arm pieces and hands can be all in one, in which case the material used should be flesh-coloured. The hand is sewn like a baby's glove with the thumb uppermost. The neck is then gathered and sewn on to the tube. Be careful not to close up the tube while doing this.

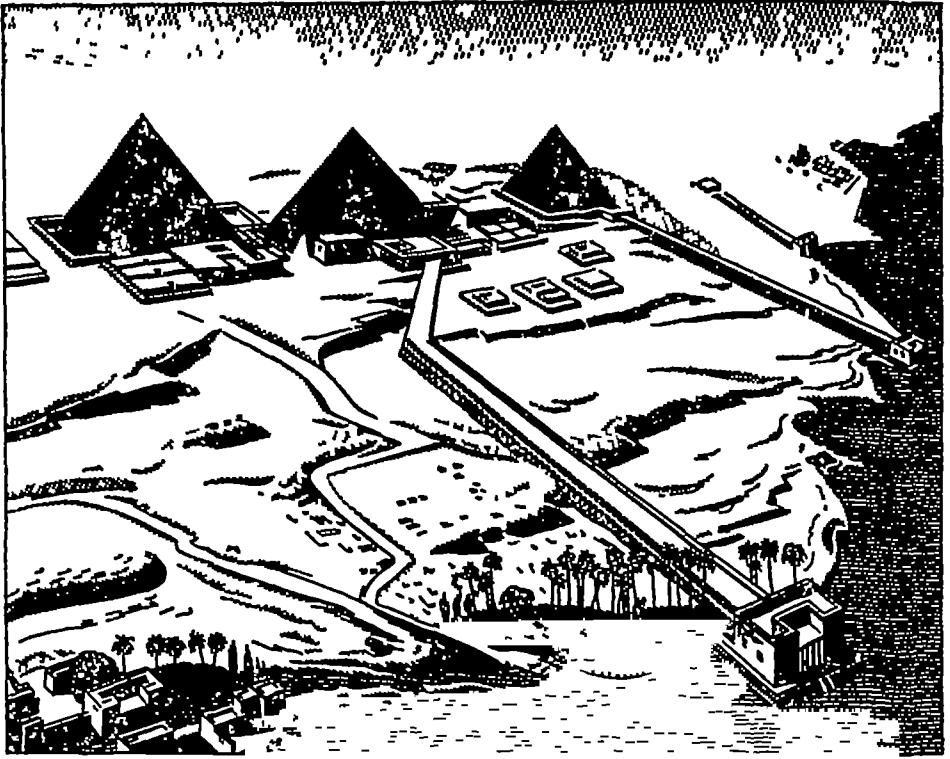
Clothes to give the puppet character can be added to the shirt, but do not pull the waist in or you will be unable to get your hand inside.

To work the puppet, place your forefinger in the neck, thumb in one arm and second finger in the other. Fold the other fingers in your palm. You can work two puppets yourself, or you can get a friend to help you. When working the puppets rest your arm against the edge of the stage whenever possible, as this is less tiring. A clothes horse covered with a rug makes a good Punch and Judy Theatre, or you could make yourself a theatre from an old wooden box, with a shelf in front as a stage for the puppets to act on. A thin curtain will hide you from the audience while enabling you to watch your puppet's actions.

Fairy stories make good plays, but choose those with plenty of action. Gramophone records of ballads or comic songs are good.



What you need for making a puppet to be worked by the hand



How the pyramids probably looked when first built

to practise with, and help to make an effective entertainment

PURCELL, Henry (1658-1695) was a great English composer. He wrote music for both church and stage and had an uncommonly fine feeling for the words he was setting to music.

PURITANISM was the body of political and religious principles held by the extreme PROTESTANTS, dating from Elizabeth's reign. The Puritans believed in an absence of display in church services and a strictness and simplicity of living. They were persecuted during the reigns of James I and Charles I, and many emigrated to America, including the PILGRIM FATHERS. The Puritans achieved political power under Oliver CROMWELL.

PYRAMID See MENSURATION

PYRAMIDS, THE, are enormous structures of brick or stone having a square base and sides

tapering upwards to a point, erected at the order of ancient Egyptian kings as safe and permanent tombs for themselves. They stand, chiefly in the deserts of Gizeh, monuments to the skill and industry of the people of that time. The interior consisted of a chapel, a burial chamber and a place set apart for a statue of the person buried there. See also SEVEN WONDERS OF THE ANCIENT WORLD.

PYRAMUS and **THISBE**, in ancient MYTHOLOGY, were lovers of Babylon who, owing to the opposition of their parents, had to meet in secret. One day Pyramus found the cloak of Thisbe stained with blood and thinking she had been slain by a lion killed himself. Thisbe finding the dead body of her lover killed herself also. It is also the plot of the playlet in *A Midsummer Night's Dream*.

PYTHON. See SNAKE



QUAKERS See **FRIENDS (SOCIETY OF)**

QUARTET, a musical work for four performers See **CHAMBER MUSIC**

QUICKLIME is an alkaline powder obtained by strongly heating **CHALK** See **LIME**

QUICKSILVER See **MERCURY**

QUINTET, a musical work for five performers See **CHAMBER MUSIC**

QUIXOTE, Don, hero of a novel of that title by **CERVANTES**, was a person of lofty but impracticable ideals, formed by reading too many stories of chivalry and romance. He set out like a true knight-errant with his squire **Sancho Panza** in search of adventure, and his most famous adventure was when he charged at some windmills thinking them to be monsters. From this strange, impulsive character comes the word "quixotic."



Don Quixote and his squire

QUOITS is a game in which players try to throw iron rings over a pin, the nearest ring counting one point, while an actual "ringer" counts two points. A similar game, but played with horseshoes, is popular in the United States where championship competitions are held.

Deck Quoits is played in much the same way, but here the peg is on a strong flat base.

In **Garden Quoits**, five pegs are driven into the ground, one at each corner of a square with sides of 1 yard, and one in the middle.



Quoits in the garden

Four or six rubber rings, six to eight inches across, are thrown from a line 5 yards from the nearest peg. Rings of $\frac{1}{2}$ inch manila rope make good substitutes. Either count one point for every peg ringed, or give each peg a different number of points thus: 1 for the centre peg, 2 and 3 for the nearest pegs, 4 and 5 for the pegs farthest from you.



CHINESE



RED INDIANS OF
NORTH AMERICA



SUDANESE



PACIFIC
ISLANDER



ARABS OF NORTH AFRICA
AND ARABIA



WHITE MAN WITH PYGMIES
OF CENTRAL AFRICA

People vary from one part of the world to another in colour, clothes, customs



ESKIMOS OF
THE FAR NORTH



AUSTRALIAN
ABORIGINES



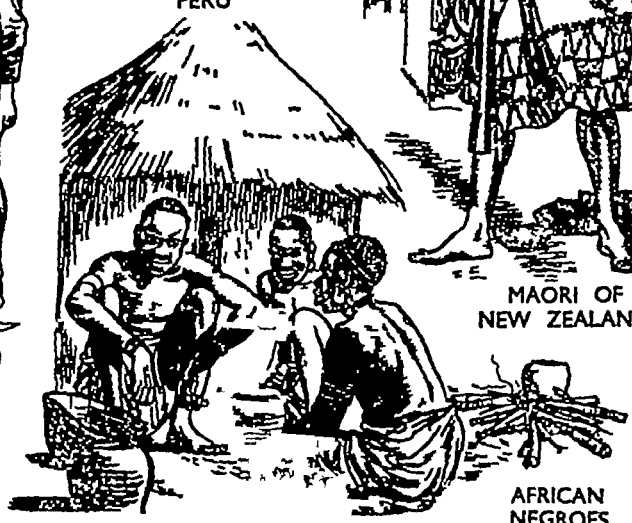
INDIANS OF
PERU



MAORI OF
NEW ZEALAND



PEOPLE OF
INDIA



AFRICAN
NEGROES



RABBIT and HARE are **RODENTS** Rabbits live a communal life in burrows, feeding on grass and other plants, especially at dusk They have many enemies and seek safety by flight underground, the white underside of the tail probably gives warning to other rabbits Baby rabbits, born in underground nests lined by the mother with her own fur, are blind, helpless and nearly naked Some varieties of rabbit are bred for food, others for fur, angora wool, or as pets Well-known types are old English, blue beveren, Dutch, Flemish giant, Himalayan, chinchilla, and angora

Hares live more solitary lives, and do not burrow Their nest of flattened grass is called a "form" Young hares, the leverets, are born with open eyes and furry coats, and remain crouched in the form in the mother's absence

RABBIT AS A PET. Pet rabbits are much happier if kept in an outdoor hutch with a wire-netting run attached The hutch should be on short legs to keep it from the damp, with a rough board nailed to the doorstep as a stairway into the run The hutch should have a front and rear compartment—with communicating doorway, of course—and a large door at one side so that you can clean it easily It must be disinfected regularly, and plenty of soft straw or hay must be provided for bedding

Separate the does from the bucks except when they are breeding Do not disturb the doe when she is about to have her young, and see that she has made her nest Supply plenty of drinking water and, after the rabbits are born, wait until she

is feeding in the run before you try to look at them Give the mother extra food at this time The young rabbits will come out and begin to feed when they are about three weeks old

Feed your rabbits on crushed oats or crushed barley and bran mixed with a little boiling water until it is crumbly allow it to cool They must also have a lot of vegetables—carrot-tops, parsley, lettuce, cabbage and cauliflower leaves, dandelion and hawthorn shoots, sow-thistle, groundsel and so on Feed them morning and evening, and remove all spilled scraps and faded leaves during the daily cleaning

RABELAIS, François (about 1494–1553), was a Frenchman who wrote the most famous books of his time, *Gargantua* and *Pantagruel*, the broadly humorous stories of two giants, in which are satirized the clergy, the universities and certain theories of education and government

RACES OF MANKIND. The word "race" denotes a group of people having well-marked physical characteristics in common One such characteristic is the colour of the skin, and on that basis mankind can be classified into the white-skinned people of Europe, Asia, America, and other parts of the world developed by white settlers, the black men of the African jungles and the Australian bush, the red-skins of North America, the yellow men of the Far East, and the brown people of North Africa, Arabia, and India There has been so much intermingling in the world, however, that no race is pure, in the sense of being free of all the

characteristics of other races See pictures on pp 476 and 477

Mankind can also be classified more scientifically according to stature, hair, and shape of the skull The science of classifying peoples into races is known as ethnology

RACINE, Jean (1639-1699), French writer of tragedies mainly drawn from classical stories, notably *Phèdre*, and one on a Biblical story, *Athals*

RACON. See FLESH-EATING MAMMALS

RADAR. We see an aeroplane in the beam of a searchlight because it reflects light into our eyes In a similar way its presence can be detected by radar (radio-location), since wireless waves sent out by a special transmitter are reflected by it and picked up by the receiving part of the instrument, where they are translated into a visible indication on the screen of a cathode-ray tube Both the transmission and receiving sets work on a very high frequency

A further development is the radar instrument carried in a plane which sends out rays to the earth which are reflected back to the plane and produce on the screen of the receiving instrument a picture of the ground underneath This was used in the war by bombers to enable them to find their target through cloud.

See pages 480 and 481

Apart from its wartime use of spotting aeroplanes and finding targets to bomb, radar has been developed for peacetime use and today helps ships and aeroplanes to navigate through darkness, fog and cloud

RADIATION. See RADIATOR

RADIATOR, the name incorrectly given to an apparatus designed to spread heat by the passage of air over its surfaces (This is

spreading heat by convection not by radiation) Thus the so-called radiator which forms part of a central heating system is in essence an arrangement of flattened tubes set side by side and designed to have as much metal surface as possible exposed to the passing air currents When the system is working, a central boiler supplies the radiator tubes with hot water or steam, and the surrounding air, being heated, becomes less dense and rises, cool air presses in below and the air motion thus created by convection helps to spread the warmth throughout each room

The name radiator could be used more fittingly of an electric fire This actually radiates heat See PARABOLIC MIRROR

RADIO-ACTIVITY. Radium, uranium and certain other ELEMENTS give off continually the products caused by the breaking up of their atoms These products are positively charged helium ATOMS, ELECTRONS and very short electromagnetic waves even shorter than X-RAYS

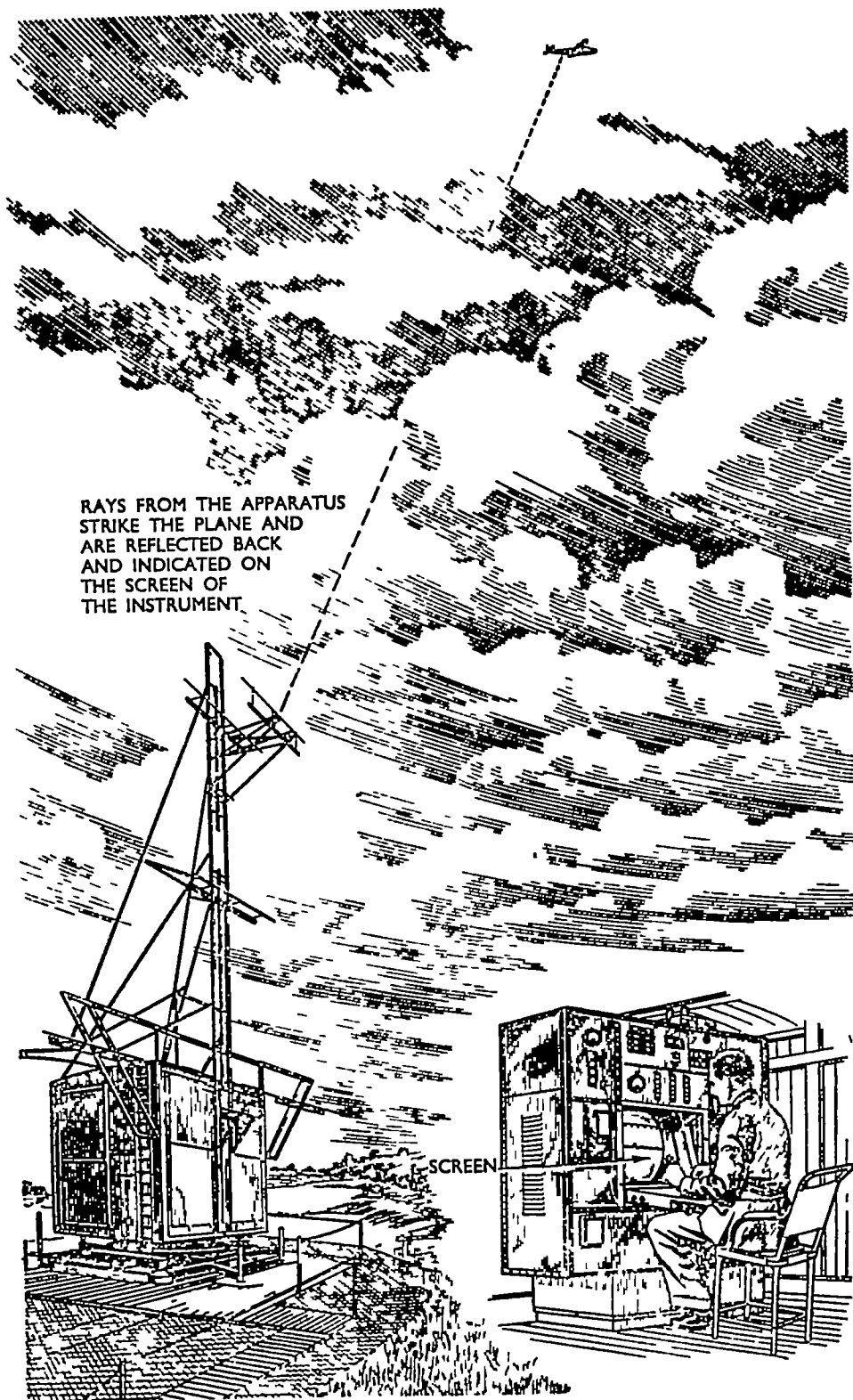
The radio-active element slowly changes to another element, and in the end the last product is the element lead, which is not radio-active

The radiation from these elements affects not only photographic plates (which originally led to its discovery), but also the behaviour of living matter

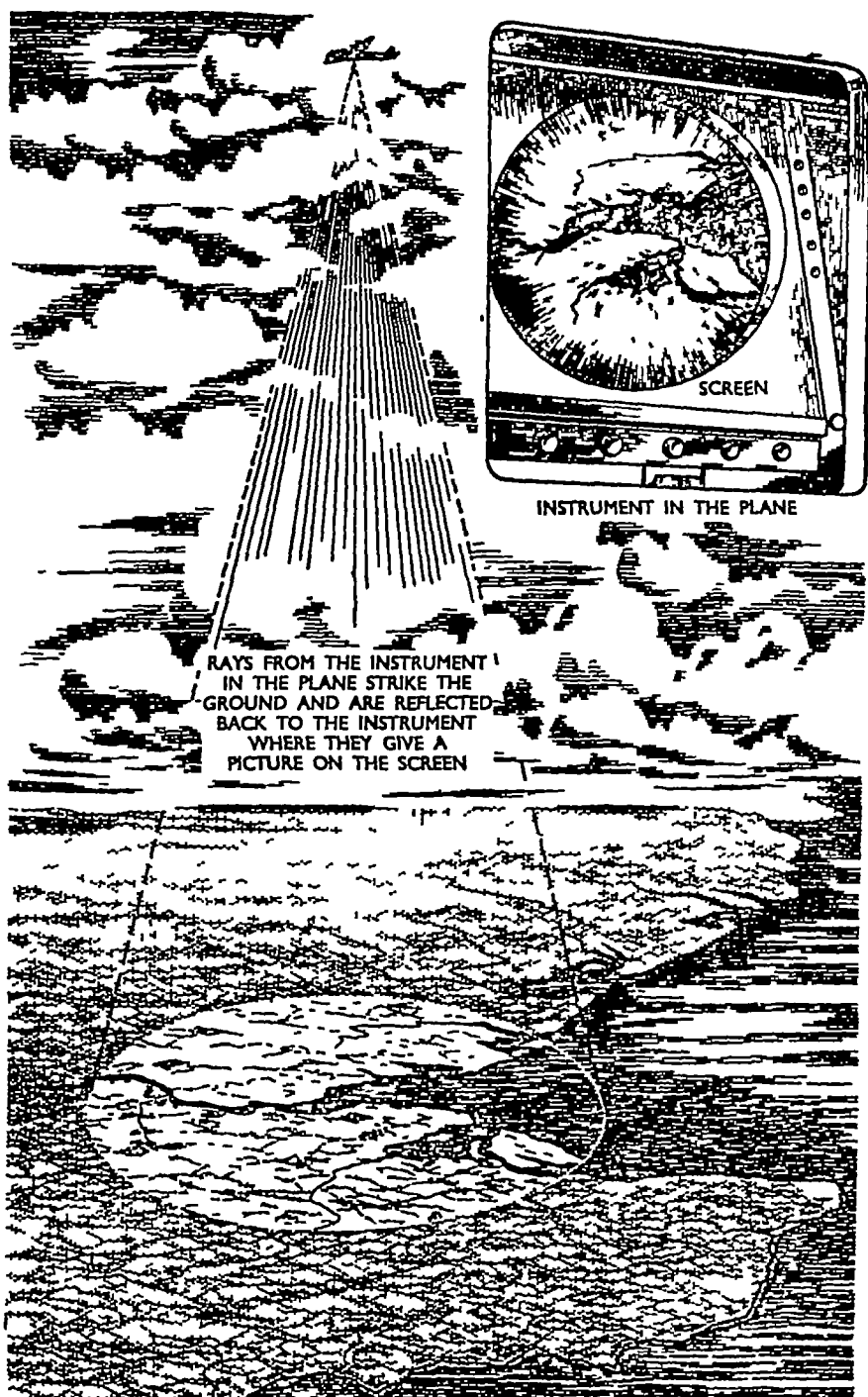
RADIO-LOCATION. See RADAR

RADIUM is a rare metallic ELEMENT originally found in pitchblende and, because of its radio-activity, used in the treatment of cancer See CURIE The minerals from which radium can be obtained are found in Czechoslovakia, the Belgian Congo, U S A, Australia, Portugal and South Africa

RADIUS See CIRCLE



Radar ground apparatus used for locating aeroplanes



RAYs FROM THE INSTRUMENT
IN THE PLANE STRIKE THE
GROUND AND ARE REFLECTED
BACK TO THE INSTRUMENT
WHERE THEY GIVE A
PICTURE ON THE SCREEN

INSTRUMENT IN THE PLANE

How radar helps the navigator of the aeroplane See page 479



Railway map of the British Isles, showing the routes most used

RAILWAYS James WATT is the inventor of the first efficient stationary engine to be driven by steam, and Richard Trevithick adapted this engine to run on rails. Then George STEPHENSON started to build railway engines, including one for the Stockton and Darlington Railway, and another, the *Rocket*, which won a prize of £500 offered by the builders of a railway between Liverpool and Manchester in 1829. As a result of his successful engine, railway construction went on rapidly. To overcome the physical obstacles in nature, bridges had to be built,

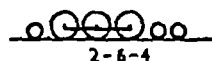
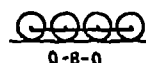
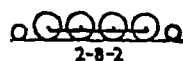
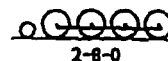
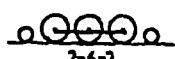
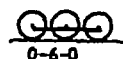
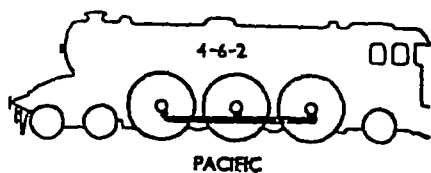
and tunnels bored. At one time there were two different gauges (distance between the rails) in use, one was 4 feet 8½ inches, the other 7 feet, and great rivalry existed between the companies using these different gauges.

Early in the 20th century the main-line railways of Great Britain were amalgamated into four companies—the London Midland and Scottish, the Great Western, the London and North Eastern, and the Southern Railway. In 1948 the railways came under State control. Today some engines are using

oil instead of coal to heat the water in the boiler (See LOCOMOTIVE) Another change is the arrival of the diesel-electric locomotive, in which a diesel oil burning engine turns an electric generator, and this generates electricity to drive the electric motors which propel the locomotive

Locomotives are classified according to the arrangement of their wheels. These wheels are of three kinds—leading or bogie wheels, driving wheels connected to the pistons, and trailing wheels supporting the cab (The wheels of the tender are not included in this scheme) If a locomotive has four leading wheels, six driving wheels, and two trailing wheels, it is known as a 4-6-2 engine. Other common wheel arrangements are given in the illustration, together with the type names for locomotives which have wheel arrangements well-known in Britain

Coaches have changed from the original open-wagon type. The sleeping car was introduced in 1874, the dining-car in 1880, and corridor trains with washing accommodation in 1890. Modern long-distance trains have, in addition, Pullman cars which are furnished exactly like a well equipped hotel lounge



Wheel arrangements often seen

Standard head codes are used on many of the various regions of the British railways to enable trains to be easily identified. These are shown in the illustration. At night, bright headlamps are used, during the day white disks or white-painted headlamps

An elaborate signalling system enables a driver to tell whether his train may proceed or whether he must wait for the stretch of line ahead to become clear



EXPRESS
PASSENGER



ORDINARY
PASSENGER



COACHING
STOCK



GOODS OR EMPTY
COACHING STOCK



EXPRESS
GOODS



THROUGH GOODS
OR BALLAST



LIGHT
ENGINE



THROUGH MINERAL
OR EMPTY WAGONS

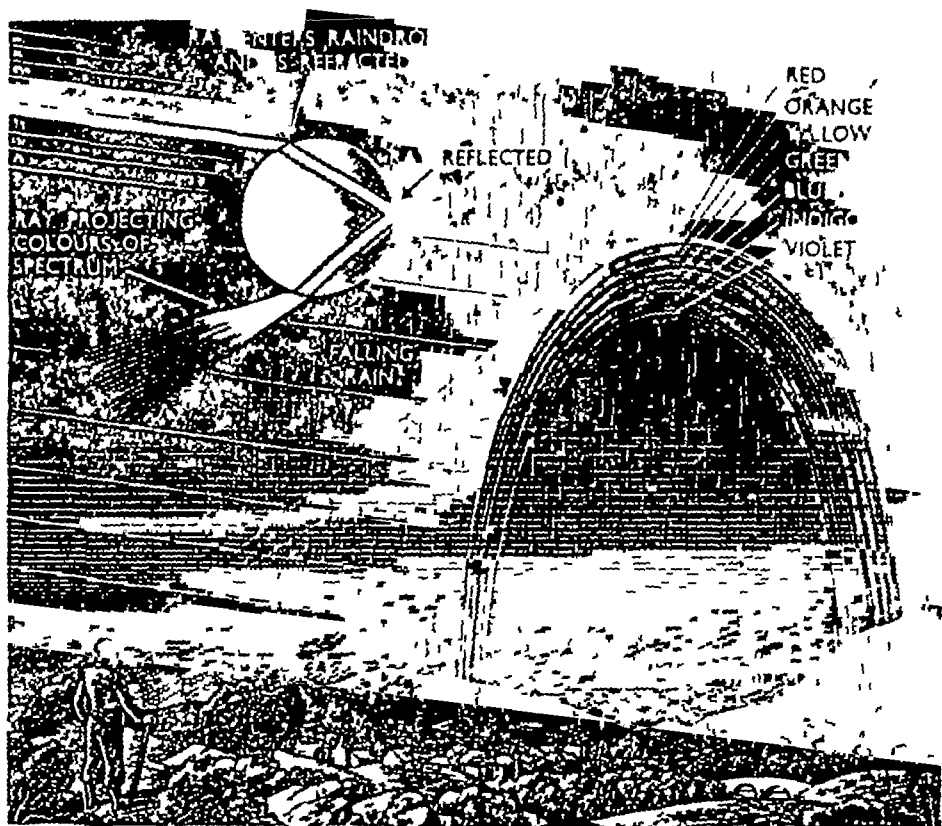


ORDINARY
GOODS



ROYAL
TRAIN

Standard head codes used in many regions of the British railways



Sunlight is split up by raindrops to form the rainbow

RAIN and RAINFALL. Rain is the moisture of the **ATMOSPHERE** condensed and deposited in drops, and rainfall is the amount of water that falls to the earth as rain, measured in inches by means of a rain gauge. A rain gauge consists of a wide funnel placed in a measuring jar. The rainfall at any place depends chiefly on the direction of the prevailing winds. Winds from the sea generally bring rain, so that places far from the sea often have little rainfall. Winds blowing away from the **EQUATOR** tend to deposit their moisture through cooling and condensation. Winds forced upwards in crossing mountain ranges are cooled and deposit rains on the windward side as they rise. The leeward side is drier, and places here are said to lie in a rain-shadow. See **CLIMATE and METEOROLOGY**

RAINBOW. The **LIGHT** from the sun coming from behind the observer and falling on distant raindrops is refracted and reflected just as by a glass prism (See **SPECTRUM**). The many colours which compose white light are sent downwards in different directions, and when the observer looks up he sees the coloured rays from successive bands of raindrops, giving the familiar rings of the colours of the spectrum—red, orange, yellow, green, blue, indigo, and violet.

RAT and the allied mouse and vole are rodents. The black rat has, since 1700, been largely replaced in Britain by the brown rat, an active **RODENT** which climbs and swims well. Both do tremendous damage to human food stores, and may carry diseases. Great efforts are made to keep down the number of rats.

The water rat is really a vole, and lives in holes in banks of streams, gnawing plants with its orange-coloured teeth. Bank-voles and field-voles, also called short-tailed field-mice, live in hedgerows and fields, keeping under cover, making runs through grass roots, and eating grass, nuts and seeds. All voles have blunter noses than true mice, and furry close-set ears. They, and wood-mice or long-tailed field-mice, may enter farmhouses and out-buildings for food.

Wood-mice are better jumpers and climbers. Brown above, they are pure white below, with orange chest marks. They have very large eyes and ears and long quivering whiskers. Minute harvest mice make ball-shaped nests in corn. They twine their prehensile tails round the stalks to hold on while eating grain. They are russet-brown with white chests, and several together weigh barely an ounce. House-mice often do much harm by eating human food and gnawing wood or tearing up paper. They are grey with long scaly tails, but the same varieties may be white, black, fawn or particoloured. Both rats and mice are used by scientists in experiments.

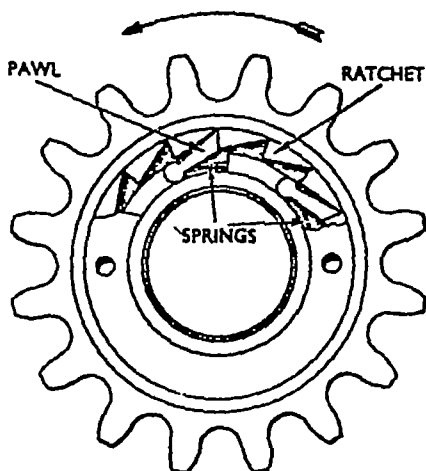
See MOUSE AS A PET

Dormice are related to squirrels, build nests of grass among hazel tree bases, and HIBERNATE for longer than other rodents. They have large, brilliant black eyes and furry ears and tails.



Rat, a menace to food and health

RATCHET WHEEL has paws that are pushed by ratchet notches when the wheel turns in one



Ratchet wheel in a bicycle

direction, thus moving the centre spindle in the same direction. When the wheel moves in the opposite direction in relation to the spindle, the ratchets slide back over the pawls, and do not affect the spindle **RATIO and PROPORTION.**

(1) The ratio of one quantity to another is the proportion that the first is of the second, the quantities must of course be of the same kind.

$$\begin{aligned} &\text{Ratio of } 12s \ 6d \text{ to } 16s \ 3d \\ &= \frac{12s \ 6d}{16s \ 3d} = \frac{50 \times 3d}{65 \times 3d} = \frac{10}{13} \end{aligned}$$

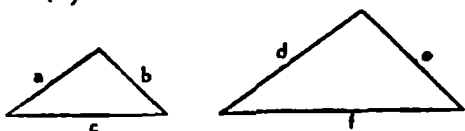
$$\begin{aligned} &\text{Ratio of } 2 \text{ feet } 3 \text{ inches to } 6 \text{ yards} \\ &= \frac{2 \text{ feet } 3 \text{ inches}}{6 \text{ yards}} = \frac{9}{18 \times 4} = \frac{1}{8} \end{aligned}$$

(2) Ratios are sometimes written in the form $x : y$ ("as x is to y ") The fact that a ratio can be written as a fraction shows that each of the terms can be multiplied or divided by the same quantity. $3\frac{1}{2} : 4\frac{1}{2} = 3\frac{1}{2} \times 6 : 4\frac{1}{2} \times 6 = 20 : 27 = 10 : 13\frac{1}{2} = 40 : 54$, etc.

The quantities are still in proportion if when we double the one we

also double the other. When a plane travels at constant speed, the distance travelled is proportional to the time. If we double the time we double the distance. $3\frac{1}{2}$ times the time gives $3\frac{1}{2}$ times the distance, and so on. That is *simple direct proportion*.

(3) The sides of similar TRIANGLES



are in proportion, so the ratios of the sides are equal

$$\frac{a}{d} = \frac{b}{e} = \frac{c}{f}$$

We can express other proportions

$$\frac{a}{c} = \frac{d}{f}, \quad \frac{a}{b} = \frac{d}{e}, \quad \frac{b}{c} = \frac{e}{f}$$

(4) Sometimes quantities are *inversely proportional*, the time taken to do a piece of work, or to consume a store of food, is inversely proportional to the number of people engaged—if we double the number of people, we halve the time. If we halve the number of people, we double the time.

(5) Areas of similar figures are proportional to the squares of corresponding lengths. Double lengths give 4 times the area. $3\frac{1}{2}$ times the lengths give $(3\frac{1}{2})^2 = 12\frac{1}{4}$ times the area, and so on.

The illumination given by a lamp is inversely proportional to the square of the distance from the lamp. If you double the distance, the illumination becomes $\frac{1}{2^2} = \frac{1}{4}$ of what it was.

The volumes of similar solids are proportional to the cubes of corresponding lengths. Double the radius of a sphere gives $2^3 = 8$ times the volume. 7 times the edge of a cube gives $7^3 = 343$ times the volume, and so on.

(6) Suppose we want to draw a smaller version of a picture, and know what reduced length we need. To find the reduced width, the unknown quantity, we say that the relation of the original length to the original width is the same as that of the new length to the unknown

quantity L . $W = l$ w , or $\frac{L}{W} = \frac{l}{w}$

To find w , multiply both sides of the equation by W and w . We get

$$Lw = lW, \text{ so } w = \frac{lW}{L}$$

Suppose L and W are 6 inches and 4 inches, and $l = 2\frac{1}{2}$ inches. We have

$$6 \quad 4 = 2\frac{1}{2} \quad w \text{ so } w = \frac{2\frac{1}{2} \times 4}{6} \\ = \frac{5}{2} \times \frac{4}{6} = \frac{5}{3} = 1\frac{2}{3} \text{ in}$$

RATTLESNAKE. See SNAKE

REACTION COIL, the part of a wireless apparatus in which, by magnetic INDUCTION, some energy is taken from a late stage in the apparatus and fed back into an earlier stage so that it is again amplified by the set.

REALISM in literature is the close depiction of life as it really is. The writer *selects* details that will give a strong impression of reality to his reader. For example, Chaucer's descriptions of his *Canterbury Pilgrims*. See also NATURALISM, ROMANTICISM and CLASSICISM.

RECITATIVE, words set to what is often little more than the wisp of a tune which follows closely the verbal accents. It is generally found in OPERA and ORATORIO as a connecting link between two items of more musical importance.

RECORDER, a FLUTE blown from the end. It was a common instrument in Shakespeare's time, and has come into use again in recent years as a simple instrument for young amateurs.

RECTANGLE. See MENSURATION

RED SEA, a long narrow sea between the deserts of Arabia and Egypt. **EVAPORATION** is intense owing to the great heat, and the water is very salt See the maps of **AFRICA** and the **NEAR EAST**

REDUCTION is the change of a unit to a smaller or a larger one

(1) Reduce
 15 tons 14 cwt 15 tons 14 cwt
 to lb We mul- 20
 tiply the tons 314 cwt
 by 20 and add 112
 in the 14 cwt 31400
 (= 314 cwt), 3140
 then by 112 to 628
 bring the cwt 35168
 to lb

We have a similar method for other quantities, e.g. pounds to shillings—multiply by 20 and add in the shillings, hours to minutes—multiply by 60 and add in the minutes

(2) Reduce 9763 farthings to £ s d We divide in turn by 4, 12 and 20 In dividing by 20 we can mark off the last figure (3), and divide by 2 If there happens to be 1 over, we should bring down the 3 after it, making 13s

4)9763
 12)2440³d
 20)203s 4³d
 £10 3s 4³d

(3) Change 60 m p h to feet per second It is best to do this in two stages, as shown here Other compound units may be dealt with in the same way

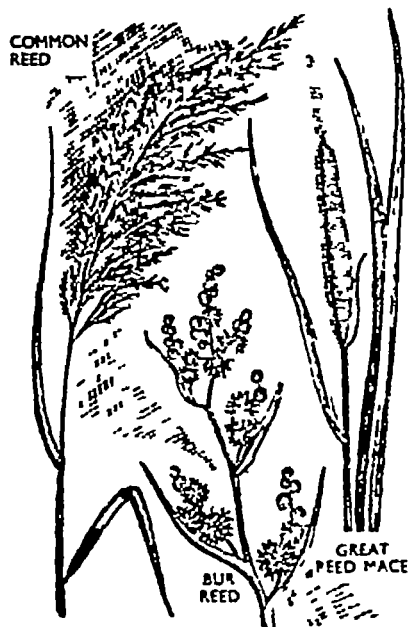
$$\begin{aligned} 60 \text{ m p h} &= 60 \times 1760 \times 3 \text{ ft per hr} \\ &= \frac{60 \times 1760 \times 3}{60 \times 60} \text{ ft per sec} \\ &= 88 \text{ ft per sec} \end{aligned}$$

REED, one of a family of flowering plants with upright leaves, growing in or near water The bulrush and reed mace may grow 8 feet high, with a velvety-brown flower spike a foot long

REED INSTRUMENTS A reed is a strip of cane or metal which is set in **VIBRATION** by being blown by the player's breath, and so produces a sound Some reed instruments have a separate reed for each note, others have only one reed, and differences in pitch are produced by lengthening or shortening the column of air in the tube to which the reed is attached

The simplest instrument of the first type is the *mouth organ* (often called a *harmonica*) Here the reeds are operated by the player's breath on a "suck-blow" principle This principle also explains the action of the *concertina* and the *piano-accordion*, but in these cases the blowing power is a bellows The piano-accordion has a small keyboard like a piano for the right hand and has now become very popular with dance bands

The *oboe* is one of the most ancient of wind reed instruments It consists of a conical wooden tube



Some very common reeds

with a double reed, the pitch of the note being varied by lengthening or shortening the column of air in the tube This is done by means of keys It is the soprano instrument of its family in the orchestra The alto oboe is called the *cor anglais* or *English horn* (though it is difficult to say why, as it is neither a horn nor English) Its range is a fifth lower than the oboe See INTERVAL

The bass instrument in this group is the *basoon*, the tube of which is so long that it has to be doubled on itself, and a curved blow-pipe is required to bring the reed to the player's mouth Composers can, if they wish, get a lower octave still by using the *double basoon*, a still larger member of the oboe family

The *clarinet* has a cylindrical wooden tube and a single reed, and has a rounder quality of tone than the oboe Clarinets are to be heard in every orchestra, and they have also been used in chamber music, as in the quintets for clarinet and strings by Mozart and Brahms, and in other combinations too numerous to mention The other members of this family that can be heard in the orchestra are the *corno di bassetto* (a tenor clarinet) and the *bass clarinet*

The *saxophone* is nowadays, through its universal use in dance bands, probably the most widely known reed instrument It has a conical tube like an oboe, a single reed like a clarinet, but it is made of brass, not wood There are twelve saxophones of different sizes, but only a few are in ordinary use See also BAGPIPE, HARMONIUM, and the picture on pages 404-405

REFERENDUM, the term used for the reference of some question to the decision, by means of a vote, of all the electors in a country

REFINERY, a factory in which a crude substance in its natural state

is treated so as to bring it into a purer state in which it is suitable for human consumption or for further industrial use, e g sugar, oil

REFORMATION, the troubled period of European history—from the 15th to the 17th century—when many religious and political changes took place

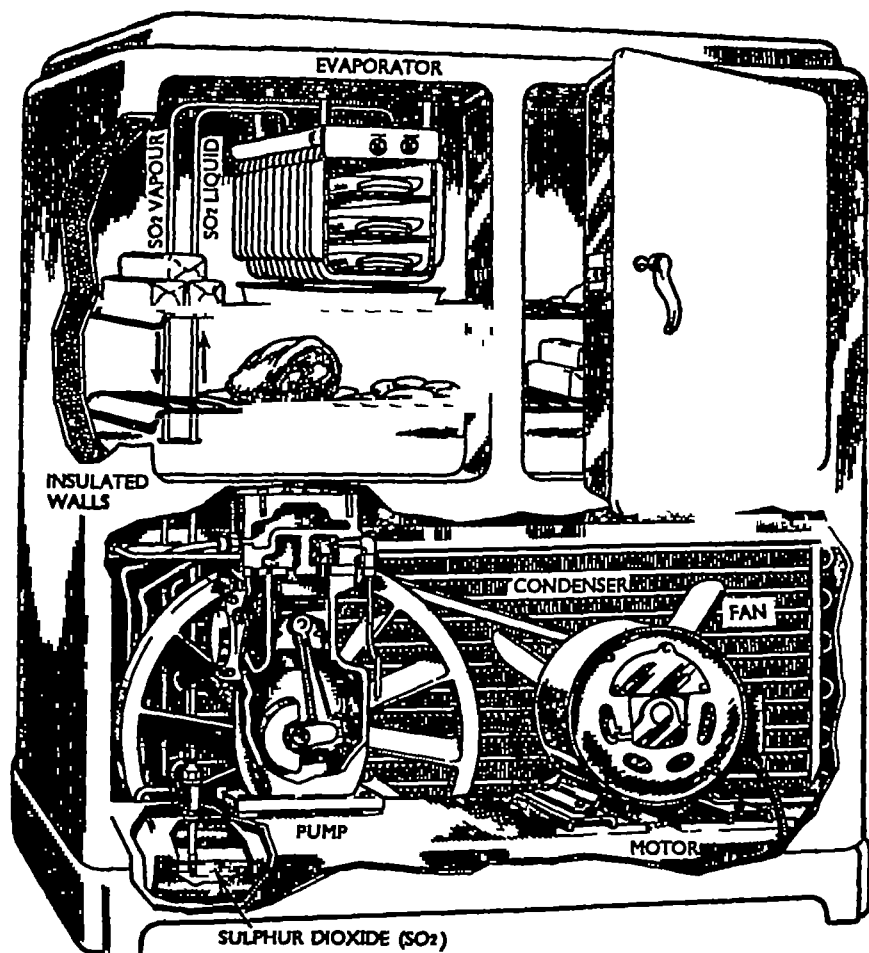
In England, the changes began with the teaching of John WYCLIFFE, but it was Henry VIII's quarrel with the Pope that separated this realm from the Roman Church In Germany, LUTHER was the leading figure in the Reformation Other great religious reformers were CALVIN, KNOX and Zwingli

Among the causes of the Reformation were the increase of knowledge, making men more able to think freely for themselves, the spread of the study of Greek literature, especially of the New Testament, originally written in Greek, and the invention of printing which made books plentiful and cheap Men began to translate the Bible into the language of the people Luther translated it into German, and Coverdale, Tyndale and others into English The services in church, too, came to be said and sung in the ordinary language, not Latin

Many people wished for these reforms, others maintained their loyalty to the ancient Catholic Church and to its head, the Pope in Rome In Europe the Reformation led to the Thirty Years' War when Germany suffered far more than she did at her defeat in the Second World War

REFRIGERATOR, a machine for creating an artificially low temperature in an enclosed space, its usual object being to store food in conditions which prevent it going bad

The commonest means of refrigeration makes use of the fact that, when a liquid evaporates, it



Liquid turning to gas in evaporator takes heat from the space around

takes in heat energy and produces local cooling. In a refrigerator, the liquid used is one such as sulphur dioxide or ammonia, which easily turns to a gas when the pressure on it is reduced.

The liquid goes through coils in an evaporator inside the box, which is "lagged," i.e. its walls covered with bad heat conductors, inside these coils the pressure is reduced by means of the pump, and the liquid—say, sulphur dioxide—evaporates, absorbing heat energy and so cooling the box and its contents. The sulphur dioxide vapour is

sucked out of the evaporator coils and then compressed in the pump, then forced into another set of coils, the condenser, where it is cooled and condensed back to a liquid, giving off its heat energy to air, cooled by a fan. The liquid sulphur dioxide now passes back through a valve to the first set of coils in the evaporator, where the whole process begins again. The motor driving the pump is often controlled by a THERMOSTAT, so that the cooling process operates only when the temperature inside the box rises above a particular pre-determined point.

REINDEER. See **HOOFED MAMMALS, TRANSPORT**

RELAY, a piece of apparatus, usually electrical, whereby a weak effect coming from a distance is used to control the flow of power from a nearby source. Relays using **THERMIONIC VALVES** are used a great deal in telegraphy and telephony.

RENAISSANCE means "re-birth," and is a name given to the Revival of Learning which started in Italy and slowly spread through Europe, affecting England in the 15th-16th centuries. It was enormously helped by the invention of printing.

This revival of learning received a great impetus, when in 1453 Constantinople was captured by the Turks. The scholars in the city of Constantinople, who studied the priceless old manuscripts containing the wisdom of the Ancient GREEKS, the greatest thinkers of the ancient world, now fled from the Turks to the cities of Italy, taking their precious books with them. There they set up schools in which the Greek language and learning were studied. With the help of the printing presses, these old books were multiplied, and there was a great increase in knowledge and in the spirit of inquiry and experiment. Much that the Greeks had discovered in geography, astronomy and other sciences had been forgotten in Western Europe, and so men in Europe spoke of "The New Learning," though some of it was old. One of the books written in Greek was the New Testament, and the study of it in its original language was a great help to religious reformers. See **REFORMATION**.

This also was the time of the rise of modern science. **COPERNICUS**, a Polish monk and scholar who died in 1543, declared the sun (not the earth) to be the centre of the uni-

verse. **GALILEO** of Pisa improved the telescope. Explorers like Columbus and others used the new science and improved our knowledge of world geography. See **EXPLORATION**.

Beautiful statues and works of art were also brought to Italy, and a great awakening in ART followed—it was an age of great painters and sculptors, including Michelangelo, Benvenuto Cellini, **LEONARDO DA VINCI**, Titian, Raphael, as well as the Flemish painters, Rubens and Van Dyck, and the Spanish painter, Velasquez.

Finally, the Renaissance was an age of many other learned men, such as Erasmus and Sir Thomas More.

REPTILE, a class of cold-blooded VERTEBRATE animals, generally covered with scales. They hatch from eggs, are in form like their parents, and breathe by lungs. Reptiles include the SNAKE, LIZARD, CROCODILE, TORTOISE AND TURTLE.

RESIN is a gum which after oozing out of certain plants has set into a hard mass which is insoluble in water. There are many synthetic resinous substances which are the basis of PLASTICS, made up from ORGANIC matter.

RESPIRATION is the process by which oxygen in the air is taken into the lungs and conveyed by the blood to all parts of the body, every living cell needs oxygen in order to obtain energy from its food. In man, air passes through the nostrils, back of the mouth, glottis and larynx, down the trachea (windpipe) to the bronchi and into the lungs. On the way it is warmed, moistened and filtered from dust. In the lung the tubes branch finely, ending in minute air-sacs with very thin walls. Through these walls the exchange of gases takes place between the BLOOD in the capillaries of the pulmonary artery and the air breathed in. Oxygen from the air

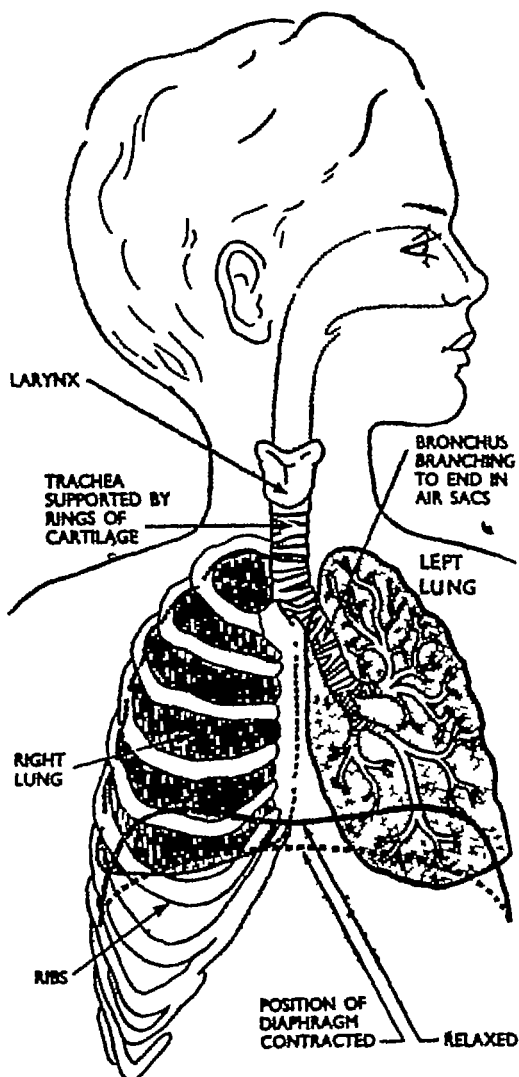
passes inwards and waste carbon dioxide and water vapour pass out, so changing the composition of the breath. Lungs and heart fill the cavity inside the thorax, which has an internal lining, the pleura. When the muscles between the ribs contract, the ribs are drawn upwards and outwards. The arched **DIAPHRAGM** contracts and flattens downwards at the same time, so increasing the space inside the thorax. The pressure is lowered, so the elastic walls of the lungs expand, and air is drawn in. When the muscles relax, air is squeezed out again. The normal breathing rate is about 12-18 times a minute. **GILLS** are used instead of lungs by fish and other water animals, which breathe oxygen dissolved in water. See also **CIRCULATION OF THE BLOOD**.

Plants absorb and use oxygen for extracting energy from food.

RESURRECTION The New Testament gospels relate that, on the first Easter Day after His crucifixion, **JESUS** rose from the dead. It is told how the tomb was found empty and how **Jesus** appeared to His disciples before He ascended to Heaven.

RETAILER, one who sells goods direct to the public usually in a shop or stores. He is the last link in the chain of **PRODUCTION** from the grower to the final consumer. See **COMMERCE**.

REVELATION in the Christian sense is the knowledge of God which God gives to men. Christians



Respiratory system whereby oxygen is absorbed into the blood

seek this revelation in the creation of the universe, and in history, but most of all in the Bible, and **JESUS's** life, told in the **NEW TESTAMENT**, is the final revelation of God.

REVIEW See **CRITICISM**.

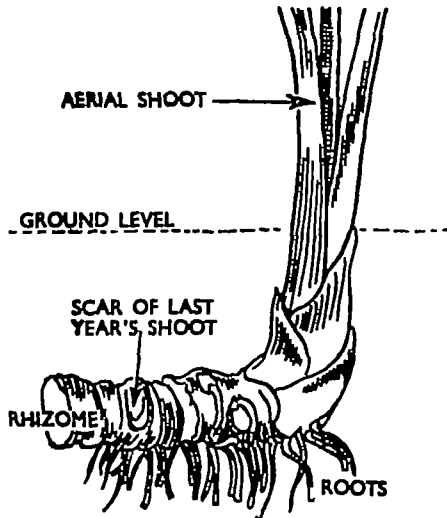
REVOLUTION, in the political sense, is the overthrow by force of an existing government and the setting up of a new one.

RHINE, one of the great rivers of Europe, rises in the Swiss Alps.

and flows through a rift valley between GERMANY and FRANCE, forming the frontier for part of the way. It ends in a delta (see RIVER) on the North Sea in HOLLAND

RHINOCEROS. See **HOOFED MAMMALS**

RHIZOME, a plant stem which grows horizontally underground,



Rhizome, underground plant stem

instead of upright, and bears roots underneath and sends up shoots above. Often rhizomes store food. The iris and Solomon's seal are flowers with a rhizome.

RHYME. See **PROSODY**.

RHYTHM in music can mean the regular recurring accent or beat in a piece of music, but it can also mean the grouping or pattern of the notes as they occur in a melody, e.g. a succession of short, rapidly played notes constituting a quick rhythm. For rhythm in poetry, see **PROSODY**.

RICHARD I (reigned 1189–1199), called "the Lion Heart," was the son of Henry II. Of the ten years of his reign only six months were spent in England.

He joined the Third CRUSADE and became a hero of chivalry, a brave

soldier, strong and fearless, though the Crusade failed to take the Holy City from the Saracens. On his way home, Richard was shipwrecked and taken prisoner. His subjects had to pay a heavy ransom to secure his release, but after a few weeks in England (1194) he crossed to France, and spent the rest of his life in wars with the King of France.

RICHARD II (reigned 1377–1399), son of the Black Prince, succeeded his grandfather, Edward III. Four years later, in 1381, the Peasants' Rising took place. Next, Richard was faced with much discontent and striving for power among the nobles. In 1399, his cousin, Henry, Duke of Lancaster, headed a rebellion. Richard surrendered, and the Duke became king, as Henry IV. Richard died soon afterwards in Pontefract Castle in 1400.

RICHARD III (reigned 1483–1485) Richard, Duke of Gloucester, was the brother of Edward IV. When Edward died leaving two young sons, Richard was appointed Protector, and he persuaded Parliament to offer the crown to him. His acceptance made him many enemies, and their number increased when it became known that the young sons of Edward IV had died in the Tower, probably murdered by their cruel uncle Henry Tudor, Earl of Richmond, the leader of the Lancastrians, invaded England. Richard was defeated and slain in the battle of Bosworth, and Henry Tudor became king as Henry VII.

RIOT, a disturbance of the peace in which a crowd damages property or injures people. In such cases a JUSTICE OF THE PEACE, SHERIFF, or MAGISTRATE may read the Riot Act, whereupon the crowd must disperse or its members be considered guilty of felony. See **LAW COURT**.

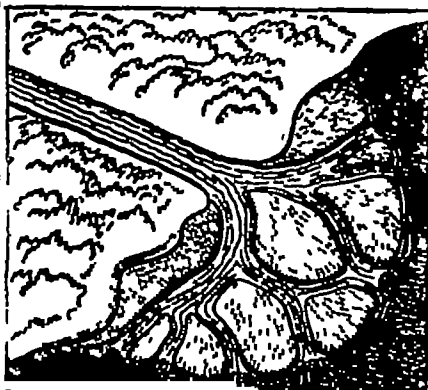
RIVERS are natural streams flowing in the channels which they have worn out for themselves, and together with their tributaries draining their own areas or basins. The region between adjacent river basins is called a watershed.

The course of a river may usually be divided into three parts. In the upper or mountain section the river deepens its valley rapidly and large amounts of coarse sediment are carried by the swiftly flowing stream, **WATERFALLS** and rapids are common and the valley cross-section is a narrow V-shape. In the middle or valley section the current slackens, and only small pebbles and fine sediment are carried, the river widens rather than deepens its valley and the cross section is a wider V-shape. In the lower or plain course only fine silt can be carried by the slow current, at flood time, this may be deposited as alluvium over a wide flood-plain. Alluvium forms a fine mixed soil of great fertility. As the river slowly winds across its flood-plain, the bends become accentuated, often horse-shoe shaped.

Estuaries occur where tidal flow from the sea keeps the river mouth



River broadening its valley

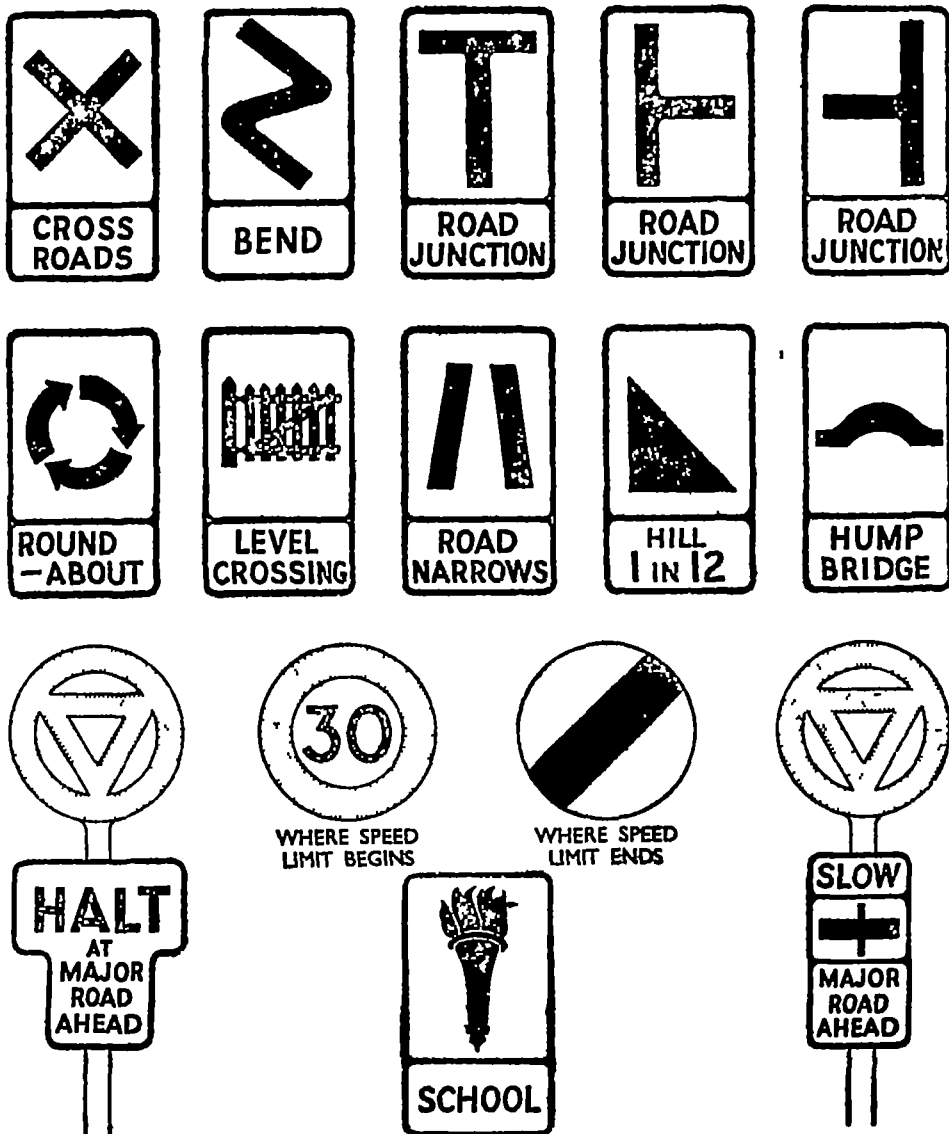


Delta at the mouth of a river

fairly free from silt, but if there is little or no tidal flow, the river deposits accumulate and in time partly block the outlet, splitting the river into two or more channels. The additional land formed is called a delta. Examples of very big deltas are those at the mouths of the Nile and Ganges.

Rivers have played a great part in man's history. Along their valleys he has migrated, near them he has founded cities, he has used them for communication, and their floods have often enriched his soil.

ROAD SAFETY. Now that the roads are so full of traffic, it is very necessary to keep a sharp look-out when we are crossing the road. The following are some useful hints for avoiding accidents. Always look up and down the road before crossing, and only cross if there is no traffic coming. Always cross busy roads if possible at a pedestrian crossing, keeping between the lines of metal studs. Look carefully both ways before passing in front of or behind a stationary vehicle. Never play "Last Across." Don't follow a ball into the roadway if there is any traffic about. Never, never hang on to the backs of vehicles.



Road signs are erected to tell road-users what lies ahead

ROAD SIGNS. When we are out walking or cycling it is necessary to notice the road signs as this helps us to travel in safety, since the signs give us ample warning of what lies ahead of us. The illustration shows the most important of them.

ROBIN, a small brownish bird resident in Britain, with red breast in both cock and hen. It nests in holes and crevices. The young have speckled breasts. Each pair takes a

definite area of garden or hedge-row during the breeding season and repulses intruder robins, but during the winter males and females guard separate territories.

ROBIN HOOD is the hero of many stories dating from the 14th century. He is supposed to have lived in Sherwood Forest, Nottinghamshire. His companions were Maid Marian, his wife, a jolly priest, Friar Tuck; Little John, who was very tall, Alan-a-Dale, and Will

Scarlet Some of his adventures are associated with the city of Nottingham. He is said to have lived in the reign of Richard I.

ROBOT. This is a Czech word meaning "work," used by the Czech writer Karel Capek in his play *RUR* (Rossum's Universal Robots), which dealt with mechanically constructed workers. Today we apply the term "robot" to any device which does the work of the human mind; one example is the automatic pilot for ships and aeroplanes.

ROCK, which now forms the earth's crust, is composed of mineral particles welded together under great heat or pressure. Sandstone, for instance, is made of sand particles that have settled under water and become cemented together through the action of lime.

ROCKET, a cylinder open at one end containing a quick-burning fuel which as it burns forces out a stream of hot gas at high speed from the open end of the case. The internal pressure on the closed end of the case drives it forward.

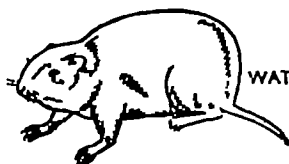
Originally used for amusement, the rocket is now a war missile, a means of propelling vehicles, or of assisting aeroplanes to take off.

ROCK GARDEN, that part of the garden used for the growing of those plants which, because their natural home is on mountain slopes, are called Alpines. They are very hardy plants, managing to exist in mere handfuls of soil in the corners and cracks between rocky boulders.

RODENT, an order of MAMMALS including all those whose incisor teeth go on growing throughout life, since they wear down with gnawing. British rodents include the hare and RABBIT, SQUIRREL and dormouse, and the mouse and RAT, while the guinea-pig, beaver and porcupine are familiar foreign types.



WEASEL



WATER VOLE



FIELD VOLE



HARVEST
MOUSE



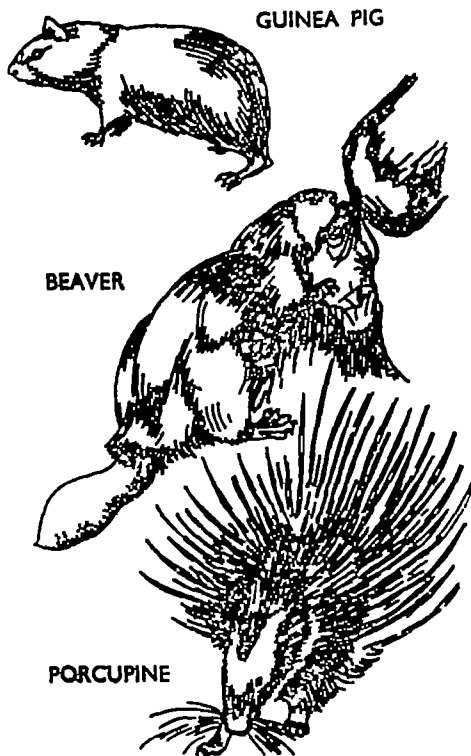
WOOD MOUSE



DORMOUSE

Rodents of the countryside

From the wild guinea-pigs of South America many varieties with long or short hair have been bred as pets. Beavers dam Canadian lakes by felling trees with their teeth, and skilfully build lodges of wood and mud for winter homes. Several types of porcupine, some of which burrow, live in Africa, India and Canada and tree-dwelling forms in tropical America. They erect their long, sharp, brown and white quills for defence. Rodents prefer to hide rather than to fight, flesh-eating animals prey upon many of



Three foreign rodents

them, but most breed so freely that their numbers remain fairly constant.

ROMAN BRITAIN. Although Julius Caesar visited Britain in 55 and 54 B C, it was not until about a century later in A D 43 that Rome began the conquest of the island. Roman soldiers crossed from Gaul, and within three years had conquered it as far north as the Humber and as far west as the Severn.

Beyond the Severn, a brave British chief named Caradoc (or Caractacus) had made a camp from which he defied the Romans for another six years. At last the Romans took the stronghold, and Caradoc was defeated in battle.

Nearly ten years after the defeat of Caradoc, a British queen, Boadicea, headed a revolt, and burned the Roman towns of Colchester, Verulamium (St Albans)

and London. But she was defeated and poisoned herself.

The Romans never held the north of Britain, inhabited by the fierce Picts, or "Painted People." When the Emperor Hadrian visited Britain in A D 120, he had a wall built from the Solway Firth to the Tyne, a distance of seventy miles, to keep back the Picts.

For nearly four hundred years the Romans ruled in Britain, giving the people law and peace. They made fine roads and bridges, and helped the people to grow better crops. Then, in 410, the Roman soldiers were called back to defend Rome from the attacks of Goths. Soon the barbarian Saxons and Angles came from over the sea to invade Britain and, in due course, formed England (Angle-land). See **ANGLO-SAXONS**.

ROMANCE. See **ROMANTICISM**.

ROMAN NUMERALS, the system of writing numbers by letters used by the ancient Romans, and sometimes in inscriptions and dates nowadays.

I is 1 II is 2 III is 3. Then we employ the symbol V (5) and write I to its left, which has the effect of subtracting one from the symbol V. So IV is 4 V is 5. When I is written to the right of V it has the effect of *adding* 1, therefore VI is 6, VII is 7, VIII is 8. Then we use the symbol X (10), and the same applies. IX is 9, X is 10, XI, XII, XIII are 11, 12 and 13 respectively. XIV is 14 (ten plus five minus one), XV is 15, XIX is 19 (ten plus ten minus one), XXXIII is 33 and so on.

For higher numbers we proceed in the same way. L is 50, so XL is 40; LX is 60, LXXXVIII is 88 (50 plus thirty plus five plus three), C is 100, so XC is 90, CCCIX is 309.

D represents 500, and M 1000, therefore MCMXLVIII is 1948.

On clock and watch faces IIII is often written instead of IV

ROMANS. See ROME

ROMANTICISM in literature is the spirit and outlook which prefers things which are distant and difficult to attain to those near and familiar, prefers the challenging unknown to that which is fully understood, prefers strong emotions and bold gestures to moderation and rational behaviour. A *romance* is therefore a tale, say, of love or adventure, in which the events are more wonderful—more “exciting”—than those of everyday life

ROMANTIC REVIVAL, a movement in the literature of most European countries towards the close of the 18th century. Literature became infused with emotion and passion, humour and pathos replaced wit, often satirical, and the critical, familiar common-sense attitude towards life, characteristic of writers of the 18th century like POPE and Dr. JOHNSON, was succeeded by a sense of wonder at life's many mysteries. Among the best known English poets of the romantic spirit are WORDSWORTH, COLERIDGE, KEATS, SHELLEY and BYRON

ROMANTIC SCHOOL, a group of composers of the nineteenth century, whose musical thought was much influenced by life, literature, painting and nationalism, and whose descriptive compositions echo dramatic scenes, characters, and emotions. Foremost in this school are BRAHMS, BERLIOZ, CHOPIN, GRIEG, LISZT, MENDELSSOHN, SCHUMANN, TCHAIKOVSKY, WAGNER

ROME, once the centre of a great empire, is said to have been founded in 753 B.C. This little settlement on the Tiber with its well-trained army conquered its neighbours and in due course the whole of Italy. But in Africa, on the other side of the Mediterranean Sea,

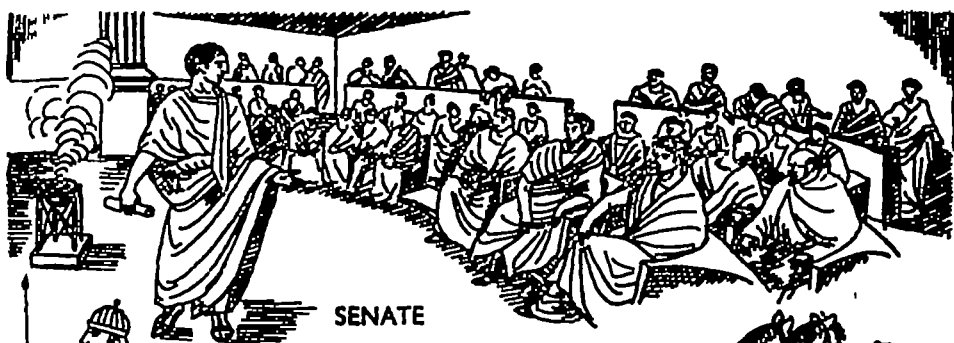
was the Phoenician city of Carthage, then the wealthiest city in the world. Rome and Carthage became bitter rivals, and were at war with each other for over one hundred years. These were the Punic Wars, from *Punicus*, the Roman name for Phoenician. See PHOENICIANS

During the Second Punic War, 218–202 B.C., the famous Carthaginian general, Hannibal, marched a great army through Spain and France and over the Alps into northern Italy, but he never reached Rome itself. On his return to Carthage, he was defeated by the Roman general, Scipio, who had crossed to Africa to attack Carthage. In the Third Punic War, 151–146 B.C., Carthage was completely destroyed

One of the greatest Roman generals was Julius CAESAR, who conquered Gaul (France), and twice visited Britain (55 and 54 B.C.). Caesar was murdered in 44 B.C., but later his nephew, Octavius Caesar, became the first Roman Emperor, with the title of Caesar Augustus. Later emperors of Rome took the title of Caesar

Rome became a great city with palaces, temples, baths, and open-air theatres, arches to celebrate famous generals, and circuses (amphitheatres) in which trained men, known as gladiators, fought each other with swords, tridents and nets—often killing each other “to make a Roman holiday”. They made sacrifices of animals to their gods, and had a Senate to pass laws. They also used the horse-drawn chariot for travelling, racing and for fighting

The Roman Empire, crossed by its splendid roads, attained its greatest size under Trajan, when it extended from the Atlantic to the Euphrates and from the Garamians to the Sahara. In 395,



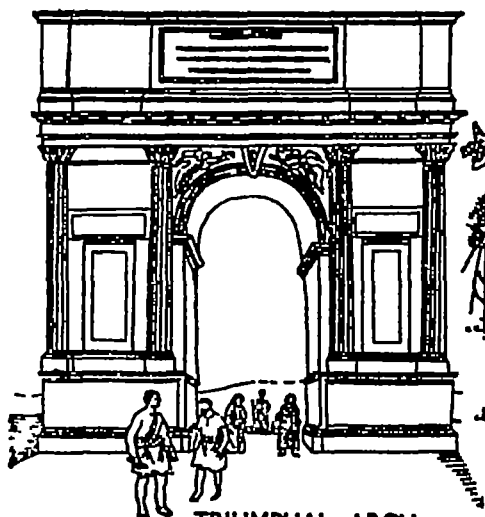
SENATE



SOLDIER



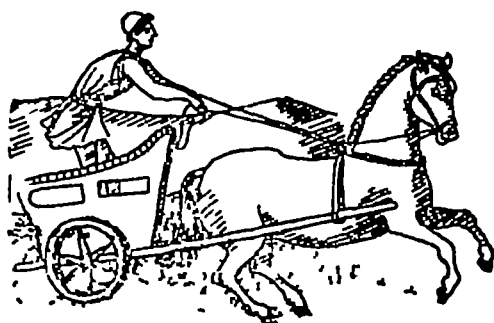
CATAPULTA—ROMAN ARTILLERY



TRIUMPHAL ARCH



SACRIFICE



CHARIOT



GLADIATORS

Scenes from life in Rome, greatest power of the Ancient World

the Empire was divided between the sons of Theodosius, one ruling from Rome, the other from Constantinople. From 410 onwards, Rome and its Empire were attacked by the Barbarians—Goths, Huns, Vandals, Franks and Saxons, and in 476 the Western Roman Empire came to an end. Then the new nations began to grow up. Roman Britain became England, Roman Gaul became France, and much later Spain, Germany and Italy took shape.

ROMULUS and **REMUS**, in CLASSICAL MYTHOLOGY, are twin brothers who, cast away to die in the Tiber, were driven ashore and suckled by a she-wolf. Later on they resolved to build a city near the Tiber, but in a quarrel Remus was slain. Romulus was father and founder of **ROME**.

RONTGEN, Wilhelm Konrad (1845–1923), was a famous German physicist who discovered λ -RAYS. While professor of physics in the University of Wurzburg, he observed that crystals of barium platino-cyanide glowed brightly when an electric discharge was passed through a nearby vacuum tube. Further experiment proved to Röntgen that this radiation had the power of passing through many materials which are opaque to ordinary light rays, and of affecting photographic plates as if they had been exposed to light, even though protected by wrappings of opaque black paper. Since Röntgen was not at that time certain of the nature of the rays he called them X-rays.

ROOK. See **CROW**.

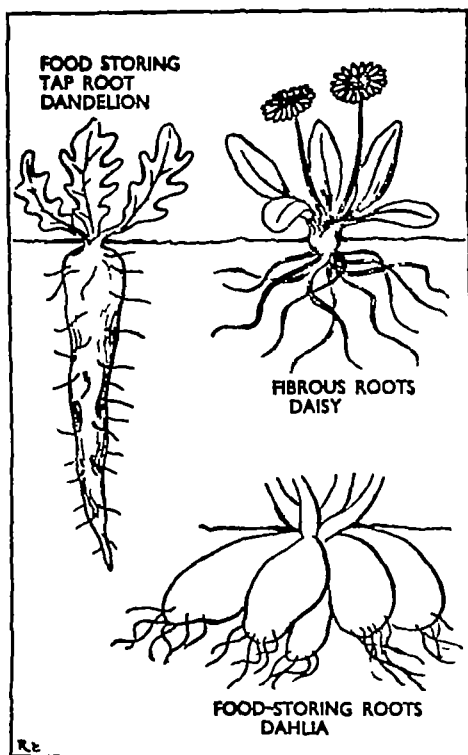
ROOSEVELT, Franklin Delano (1882–1945), was a descendant of a Dutch family which went to America in 1649. He was a lawyer by profession, and a relative of President Theodore Roosevelt. He himself became President of the



Roosevelt, world statesman

United States in 1933 during the great industrial crisis. He was thrice re-elected, in 1937, 1941 and 1945, and he was the first President to be elected for a third or fourth term of office. His famous policy for the U.S.A. during the great industrial crisis was known as the "New Deal," with its relief and development schemes for the farmers and the unemployed. During the Second World War, he had several meetings with Mr. Churchill, the British Premier, and, at one of these meetings on a ship in the Atlantic in 1941, the famous ATLANTIC CHARTER was drawn up. President Roosevelt died suddenly in 1945. He was one of the greatest Presidents of the U.S.A. and one of the greatest statesmen of the world.

ROOT. In *botany*, the root is the underground part of a plant which develops from the radicle of the seedling. A root always tends to grow downwards, towards moisture and away from light. Lateral branch roots grow out from it, and



Different kinds of root

behind their tips are numbers of minute root-hairs. The roots anchor the plant firmly in the ground, and absorb water and the necessary mineral salts through the root-hairs. See also GERMINATION.

In *mathematics*, finding a root is the opposite of finding a power. $4^2 = 16$, hence $\sqrt{16} = 4$ (the square root of 16 is 4). $3^3 = 27$, hence $\sqrt[3]{27} = 3$ (the cube root of 27 is 3).

To find the square root of a number, say 170.3025, mark off the number in pairs of figures, starting at the decimal point in each direction 1,70, 30,25, and proceed as in the example. Take the first period, 1, the highest square which will go into this is 1, so we put 1 in

$$\begin{array}{r}
 1305 \\
 1 \overline{) 17030.25} \\
 \underline{1} \\
 23 \overline{) 70} \\
 \underline{69} \\
 2605 \overline{) 13025} \\
 \underline{13025}
 \end{array}$$

the answer and subtract $1^2 = 1$ from 1, leaving nothing. Bring down the next group of figures, 70, double the figure in the answer, $2 \times 1 = 2$, and put 2 as the next divisor. Now we have to find a figure which we can put after this 2 and which when used as a multiplier for the new number now formed will divide into 70. The figure is obviously 3, for $3 \times 23 = 69$. Put 3 in the answer, and 69 will be subtracted from 70, leaving 1. Bring down the next pair of figures, 30, and double the figures in the answer as the next divisor $2 \times 13 = 26$. What number put after 26 and multiplying the new number thus formed will divide into 130? Obviously none, so put 0 in the answer. Bring down the next pair of figures, 25, and double the figures in the answer as the next divisor $2 \times 130 = 260$. What figure placed after 260 and multiplying the new number thus formed will divide into 13025? 5 will, so put 5 in the answer $2605 \times 5 = 13025$ exactly. There is now no remainder, so the square root is exactly 13.05. Notice the correct position of the decimal point in the answer: it is immediately over the decimal point in the number we are working on.

Algebraic roots are written thus \sqrt{a} = square root of a , $\sqrt[3]{a}$ = cube root of a , and so on. The square roots of minus quantities cannot be found, $\sqrt{-1}$ is an *imreal number*. See also POWERS AND INDICES, LOGARITHMS.

ROOT CROPS are vegetables grown for the use of their roots such as carrot, turnip, parsnip, beetroot.

ROSES grown in gardens are the cultivated descendants of the wild briar and other wild roses found in England, China and elsewhere. Once planted, they will continue to bloom year after year. November is the best month for planting.

The most common method of propagation is by BUDDING. The buds of an established variety are joined to a stock, usually a wild rose type, to form a new plant.

Although there are many varieties of roses, three main classes may be mentioned here, they are (1) The bush rose, probably the most popular because of the profusion of flowers produced (2) The standard, which is generally about three feet in height and branches out at the top from a single stem (3) Rambler or climbing roses, which can be trained up the side of a wall or fence, or over a porch.

Regular PRUNING—in March or April for bushes and standards, and in August for ramblers—increases the size of the blooms.

ROSES, WARS OF THE, fought in England during the latter half of the 15th century when the rival houses of York and Lancaster struggled for supremacy. The followers of HENRY VI (Lancastrians) chose a red rose as their badge, and the followers of the Duke of York (Yorkists) chose a white one. One of the most powerful men in England at this time was the Earl of Warwick, called "the King-Maker." At first he took the Yorkist side, and made the young Duke of York king as EDWARD IV. When Edward offended him, he drove him out of the kingdom, restored Henry VI to the throne, and for a time ruled in his name. Then Edward returned. Warwick was defeated and slain in the battle of Barnet, and Henry VI died soon afterwards (1471). The last Battle was fought at Bosworth, near Leicester (1485), when Richard III, the last Yorkist king, was killed, and Henry Tudor, the Lancastrian leader, became king as HENRY VII. He married Elizabeth of York and united the two Houses.



Ross fought against malaria

ROSS, Ronald, Sir (1857-1932), a British physician, devoted himself to research work in connexion with malaria which is very prevalent in hot countries, and discovered that the germs of this disease were spread by mosquitoes. In 1899, he went on an expedition to West Africa, where malaria-carrying mosquitoes were known to exist, to make a study of them.

Later he became director-in-chief of the Ross Institute and Hospital for Tropical Diseases.

ROSSETTI, Christina (1830-1894), was a poetess, religious poetry forming the bulk of her work. *Goblin Market and other Poems* appeared in 1862, the title-poem remaining her best-known work.

ROSSETTI, Dante Gabriel (1828-1882), brother of Christina, was one of the Pre-Raphaelite group of artists. See ART. Some of his poems were buried with his wife, but later disinterred and published. He also made translations from the Italian, including the sonnets of DANTE. His own love-sonnets were published as *The House of Life*.

ROTATION OF CROPS. In order to get the best out of a farm, garden or allotment, and to ensure a succession of vegetables throughout the year a cropping plan should be followed. For vegetables the area is divided into three equal plots. The vegetables are divided into groups according to the following table: A—dwarf peas, dwarf beans, onions, shallots, broad beans, runner beans, B—parsnips, carrots, early potatoes, other potatoes, spinach, beet, C—cabbages, savoys, Brussels sprouts, sprouting broccoli, kale, swedes, globe beet.

	Year	1st	2nd	3rd
1st Plot		A	C	B
2nd Plot		B	A	C
3rd Plot		C	B	A

ROUNDERS, a ball game between two teams, long popular in parks. Of recent years fixed rules have been drawn up so that serious matches can be played. There are two teams of nine, one batting, the other fielding. The pitch has posts 4 feet high. The batting stick, 18 inches long, is $5\frac{1}{4}$ inches round its thickest part. The ball, $7\frac{1}{4}$ inches round, weighs $2\frac{1}{2}$ ounces. The side wins which scores the most rounders in two innings. The players bat in turn. Each batsman is bowled one ball and unless an umpire calls "no-ball" he must run, whether he hits it or not. He runs to the first post and on to whatever post he can reach before the bowler has the ball ready to bowl again. If he does not reach the fourth post he waits touching the post he has reached, until the ball is bowled to the next batsman. When he reaches the fourth post he scores one rounder if he hit the ball, if he did not hit the ball, he scores half a rounder. On completing a rounder a batsman



A batsman is "out" if he hits a ball which is caught before it reaches the ground, if a fielder with ball in hand touches the post towards which a batsman is running or touches a batsman while he is running between posts or touches the batsman still in the batting square after he has attempted to hit the ball. A batsman cannot be caught out from a no-ball which he has the choice of hitting or not. A no-ball is one that has been jerked, bowled straight at the batsman, passes out of his reach (unless he steps out to hit it), passes him higher than his head or lower than his knee or on the wrong side, or has not been bowled under-arm. If a bowler sends a batsman three no-balls, the batting side is awarded half a rounder. If the batsman hits the ball behind the batting square he runs to the first post only, but can run on after the ball is thrown in again in front of the batting square, and scores half a rounder when he reaches the fourth post. When only one batsman is left in, he has the choice of running for either of three good balls. When

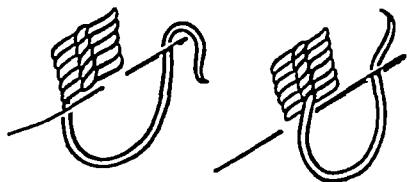
no further batsmen are waiting to go in, those still at posts can all be bounced out together by the ball being thrown into the batting square before any one of them has reached the fourth post

ROUSSEAU, Jean Jacques (1712-1778), was a French author and social reformer Like **VOLTAIRE**'s, his writings had a great influence on French thought in the years preceding the **FRENCH REVOLUTION**, especially his *Contrat Social*, which set out a new form of society

RUBBER in its natural state is the sap of certain trees which grow in subtropical regions The milky fluid (**LATEX**) from the tree is thickened with acid and then blended with other substances Other plants give a similar latex Carbon black, sulphur, chalk, etc added to rubber, give it toughness as well as elasticity

RUMANIA is a country of south-east Europe which includes the plains of the lower Danube and the forested slopes of the Carpathians The main exports include grain from the plains and oil from the foothill region The chief towns are Bucharest, the capital, the oil town of Ploesti, and the port of Constantza See the map of the **BALKAN PENINSULA**

RUMANIAN STITCH may be used as a border or filling stitch

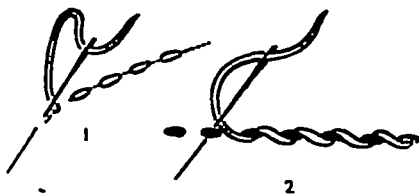


Rumanian stitch

and is worked as shown in two stages The effect is of a long stitch tied down by a shorter slanting stitch in the middle

RUNNING STITCH is much

used in plain sewing and as an outline stitch for flower and leaf sprays in embroidery It is worked from right to left Begin with a back-stitch, then make small running



Running stitch and whipped form

stitches, the stitches and spaces being equal (see 1)

Whipped running is worked after the running is completed by whipping over each stitch without taking up any material (see 2) See also **HOLBEIN STITCH**

RUSH See **REED**

RUSSIA See **UNION OF SOVIET SOCIALIST REPUBLICS**

RUTHERFORD, Ernest, Baron (1871-1937), New Zealand physicist, whose great work on the structure of the **ATOM** made possible the later developments through which atomic energy was released and made available for mankind



Rutherford examined the atom



SACCHARINE is a white powder very much sweeter than sugar, made from toluene, a coal tar by-product. Mixed with material to make it bulkier, it is sold in tablet form as a substitute for sugar.

SACRAMENTS. After the HOLY SPIRIT had come, the DISCIPLES of Jesus began to use the sacraments of Baptism and the Lord's Supper. Baptism was the outward sign used for admission to the early Church. The Roman Catholic Church also considers as sacraments Penance (or Confession and Repentance), Confirmation, Holy Orders, Marriage, and Extreme Unction (the anointing of the dying with oil).

SACRIFICE, really an offering to God. The Israelites killed animals and burnt them on the altar, and so offered them to Jehovah. Sacrifices were offered by the followers of many early religions. By Christians, the word is applied to the death of Jesus, looked upon as an offering to God to take away the sin of the world.

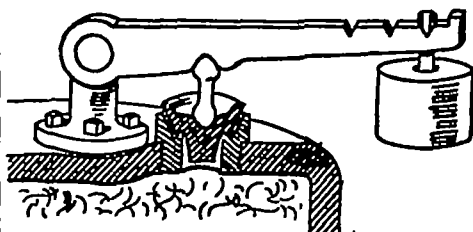
SADDUCEES were a Jewish sect in the time of Jesus who followed the law of MOSES closely but paid less attention to the later additions to it than did the PHARISEES. They did not believe in the resurrection of the body, and were more friendly to the Roman power than were the Pharisees.

SAFETY GLASS. There are three kinds of non-splintering glass. One has a layer of transparent PLASTIC in between two thin sheets of glass; when this is broken the glass splinters remain fixed to the plastic core. Another type has been heated and cooled so that it is much tougher than ordinary glass and, when broken, its fragments tend to

be round. A third type has a wire mesh embedded in it.

SAFETY VALVE, a device on a container holding a gas or liquid under pressure, which operates automatically when the pressure exerted by the gas or liquid exceeds a certain set limit, the valve allows the gas or liquid to escape until the pressure falls again below the set limit.

The illustration shows one example—a plug kept in position



One form of safety valve

by a weighted arm, which is pushed up when the steam inside the container becomes too great, some of the steam escapes, thereby decreasing the pressure, and the plug then falls back into position again.

SAINT. In the New Testament this name is given to all sincere Christians. It is used by the Christian Churches as a title of honour for certain outstanding figures of Christian history who have led specially holy lives.

SAINT HELENA is the British island in the South Atlantic off Africa where Napoleon was exiled.

SALAMANDER See FROG

SAL AMMONIAC (ammonium chloride) is a tough white crystalline substance. Dissolved in water, it is used in the Leclanché cell. See BATTERY.

SALT is the name of a chemical substance formed by the interaction

of an **ACID** and a **BASE** In addition to common salt (sodium chloride), familiar examples are Epsom salts, saltpetre, washing soda, and blue vitriol.

SALTPETRE The common salt-petre, potassium nitrate, is found in the earth, and is notable for its use in the manufacture of gunpowder It is a white crystalline substance, very soluble in water

SALVADOR, small republic of Central America The capital is San Salvador Its principal export is coffee See map of **CENTRAL AMERICA**

SALVATION ARMY, a Christian society started in 1878 by William Booth Its members wear a special uniform and are organized in ranks It works mostly among the very poor both in Britain and abroad, and undertakes many forms of social work

SAL VOLATILE is a solution containing salts of ammonia, used as a restorative in cases of fainting and shock

SAMPLER A sampler, strictly speaking, consists of **EMBROIDERY** stitches worked in a decorative way to form a design, and at the same time provide a handy reference for different types of stitches

SAND is disintegrated rock, composed largely of silica It is used in the manufacture of glass

SAND DUNES are low hills of sand found along many coasts and in some desert areas, where strong winds have aided the accumulation of dry sand particles The dunes move forward in the same direction as the prevailing winds unless the movement is checked by planting grasses and pine trees to bind the loose moving sand with their roots

SAND-HOPPER See **CRUSTACEANS**

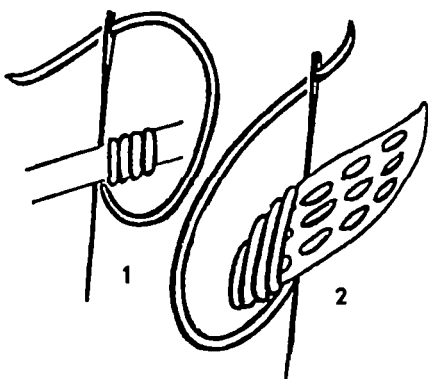
SAP acts as transport agent in plants Inside the **CELL** wall and

living **PROTOPLASM** of a plant cell is the cell sap, consisting of water with such substances as sugars dissolved in it It passes from cell to cell, some cells being specially shaped to conduct it speedily in the plant veins Water taken in by root-hairs is always rising, especially in spring Sap carries food and other necessities to all parts of the plant

SARAWAK See **EAST INDIES**

SARDINIA is a mountainous Italian island south of Corsica See the map of **ITALY**

SATIN STITCH To make this stitch, take the thread across the space to be covered, and return



Satin stitch and padded variation

beneath the material to a fresh starting point beside the first stitch (see 1)

In *padded satin stitch*, fill in the space with **RUNNING STITCH** or **STEM STITCH** first, and then work satin stitch over that (see 2)

SATURN (Greek Cronos) is, in **CLASSICAL MYTHOLOGY**, the father of the gods His reign was known as the "golden age" He was dethroned by his son **JUPITER**

SATYRS in **CLASSICAL MYTHOLOGY** are spirits of the woods and fields The Greeks called them Satyrs, the Romans, **FAUNS**

SAUDI ARABIA See **ARABIA**

SAUL was the first king of Israel. He fought continually against the Philistines and was able to unite the tribes of Israel, but towards the end of his life he became tyrannical, and was jealous of DAVID. He was killed in battle against the Philistines.

SAVANNAH. See PAMPAS

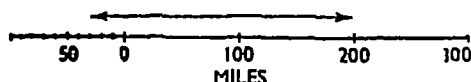
SAVONAROLA, Girolamo (1452-1498), was a Dominican FRIAR of Italy. A great and eloquent orator, he became a leading figure in the life of Florence, and its virtual ruler. But he quarrelled with the Pope, and when he fell from public favour he was arrested and tried as a false prophet and met his death by burning at the stake.

SAXHORN, name of a set of instruments, somewhat like the CORNET in general appearance, design and operation for the higher-pitched ones, and like the TUBA for the deeper instruments. Saxhorns form part of brass and military BANDS. See page 405.

SAXOPHONE. See REED INSTRUMENTS

SCALE. In *mensuration* a scale drawing is one reduced or enlarged in size from the real thing; all measurements are reduced or enlarged in the same proportion. Scales are described in two ways which mean the same: e.g. (1) 1 inch = 1 foot, etc., (2) $\frac{1}{12}$, or a reduction of $\frac{1}{12}$. In this scale $3\frac{3}{4}$ feet would be represented by $3\frac{3}{4}$ inches.

The illustration shows a scale of $\frac{1}{2}$ inch to 100 miles and will give



Scale of half-inch to 100 miles

lengths up to 400 miles. In using the scale we start at the appropriate 100 mile mark, and reckon to the left, so that the tens overlap into the end, divided section. The

arrowed line therefore represents a length or distance of 230 miles.

In using a map scale we mark the distance we want to find on the edge of a sheet of paper, and place it against the scale.

Note 1 inch = 1 mile is the same

$$\text{as } \frac{1 \text{ inch}}{1 \text{ mile}} = \frac{1}{5280 \times 12} = \frac{1}{63360},$$

$$\text{and } \frac{1}{1,000,000} = \frac{1 \text{ inch}}{1,000,000 \text{ inches}}$$

$$= \frac{1 \text{ inch}}{15.7 \text{ miles}} \text{ or } 1 \text{ inch} = 15.7 \text{ miles}$$

In *music*, the word "scale" is used to describe a ladder of notes with



The two scales used in music

steps of different sizes. There are two scales, the major and the minor, in European music.

SCALLOPING is an edging for lingerie and EMBROIDERY. The scallops should be small, padded, and worked with dainty close-packed



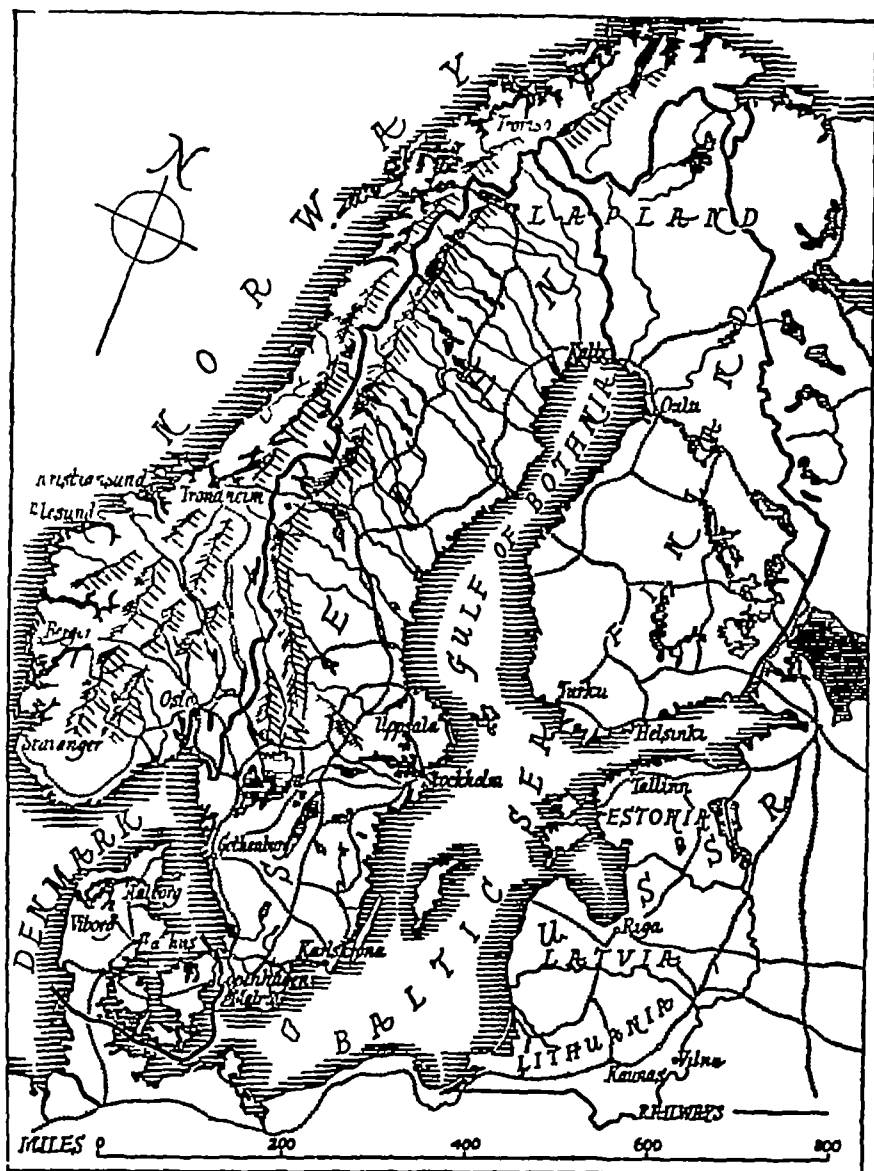
Making the scallops

stitches. To mark the scallops, use a transfer or circular shape. Pad each scallop with CHAIN STITCH, and then work each as shown with BLANKET STITCH.

SCANDINAVIA comprises the kingdoms of NORWAY, SWEDEN and DENMARK.

SCANSION. See PROSODY

SCARLATTI, Domenico (1685-



Map of Scandinavia, Finland and Baltic States of the U S S R

1757), son of Alessandro Scarlatti, the opera composer, was a composer of harpsichord sonatas, regarded as the foundation of modern keyboard composition

SCHERZO, literally "a joke," a humorous piece of music **BEETHOVEN** was the first composer to

substitute a scherzo for a minuet in a symphony See **FORM IN MUSIC**

SCHOOLS The compulsory age for attendance at school is from 5 to 15, but there are nursery schools and classes for children below that age From 5 to 11 children usually attend a primary school, and at the

age of 11 they go on to a secondary school either of the Grammar or Modern (Commercial or Technical) kind, whichever is best for their particular type of ability. After leaving school, young people can continue their education at evening schools or in the evening classes held in technical and commercial institutes.

Richer parents sometimes prefer to send their children to private schools, either day schools or boarding schools—among the latter are the famous Public Schools.

Advanced technical instruction is given at the various polytechnics and institutes, and at the Universities men and women pursue advanced courses of study which can lead to the various professions and other responsible posts requiring a trained and well stored mind.

SCHUBERT, Franz Peter (1797–1828), was an Austrian composer with a supreme gift for lyrical music. His songs and symphonies are very popular.

SCHUMANN, Robert (1810–1856), was a German composer, a warm-hearted and eager champion



Schubert, song composer

of youth and music and the founder of a paper devoted to their cause. His wife, Clara Wieck, did much as a pianist to introduce his works to a wide public and to keep his memory alive after his untimely death.

SCORPION, an ARTHROPOD animal related to SPIDERS, found in deserts and other parts of hot countries. Scorpions have three pairs of legs and a pair of pincer-like claws. The body is long and the curved tail bears a sting which in the big kinds may cause a serious wound.

SCOTLAND, the northern part of Great Britain, consists mainly of rugged mountains and moorlands, with a deeply indented coastline. Its lake and mountain scenery is famous. The climate is bleak in the north and east, and the Highlands are wild and sparsely peopled by crofters. Apart from the craft of tweed-weaving, industry is concentrated across the central rift valley Lowlands. Coal-mining is carried on in the west and near the east coast; and engineering, including great shipbuilding works, around Glasgow, the second largest city in Britain. Dundee is the centre of the jute industry. The chief ports are Glasgow in the west, Dundee, Leith and the fishing port of Aberdeen in the east. Edinburgh, the beautiful capital, is a famous centre of art and learning. See also **BRITISH ISLES**.

History In olden times the part of Britain we call Scotland was occupied by two races. Britons lived in the south, in Strathclyde, which then included Cumberland. In the north and in the south-west were fierce "painted people," the Picts. Then the Scots came from Ireland, settled in Argyllshire, and in time gave their name to the whole country. Angles occupied Lothian

in the south-east and Danes seized the northern and western islands and the extreme north-west of the mainland See ANGLO-SAXONS and BRITONS (ANCIENT)

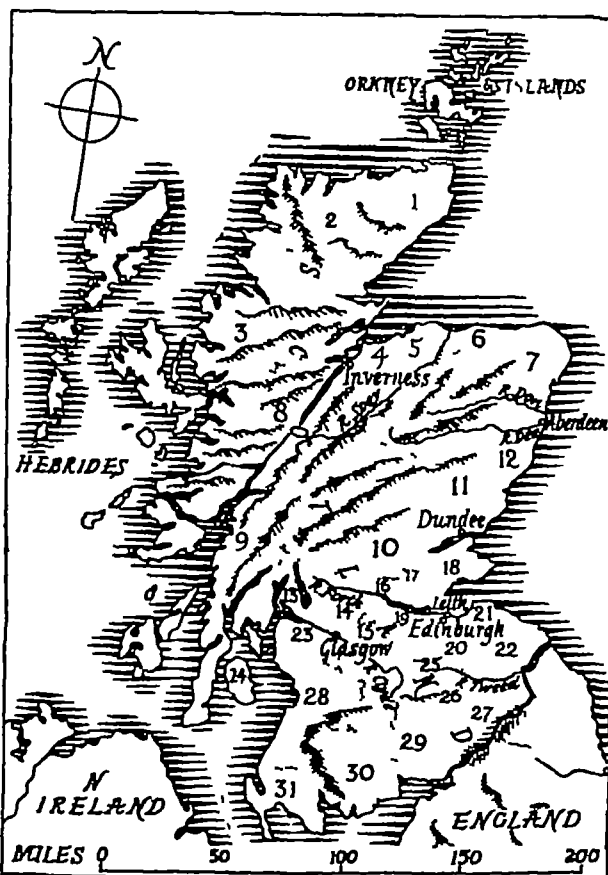
During the 9th century the Picts and Scots were united under one king, and nearly 200 years later,

in 1018, they took Lothian In the same year Strathclyde was added to Scotland, but later Cumberland was separated and became part of England In the 13th century Alexander III wrested the Western Isles from Norway

Between 1124 and 1288 Scotland

had but five kings, and made progress But on the death of Alexander III in 1288 there was no male heir to the crown of Scotland —only a three-year-old girl, Margaret, daughter of the King of Norway, and granddaughter of Alexander A ship was sent to bring the child and her nurses to Scotland, but Margaret became so ill with sea-sickness that she was landed at the Orkneys where she died

There were now thirteen claimants to the Scottish crown Edward I of England was asked to select one He chose John Baliol, probably hoping to force him to acknowledge the overlordship over Scotland which English kings had long claimed Soon war broke out EDWARD I marched into Scotland, crushed Baliol, and brought away the Scottish coronation stone,



Map of Scotland, the individual counties are as follows (1) Caithness, (2) Sutherland, (3) Ross and Cromarty, (4) Nairn, (5) Moray, (6) Banff, (7) Aberdeen, (8) Inverness, (9) Argyll, (10) Perth, (11) Forfar, (12) Kincardine, (13) Dumbarton, (14) Stirling, (15) Lanark, (16) Clackmannan, (17) Kinross, (18) Fife, (19) West Lothian, (20) Midlothian, (21) East Lothian, (22) Berwick, (23) Renfrew, (24) Bute, (25) Peebles, (26) Selkirk, (27) Roxburgh, (28) Ayr, (29) Dumfries, (30) Kirkcudbright, (31) Wigtown, the Orkney Islands, and farther north (not shown) the Shetland Islands



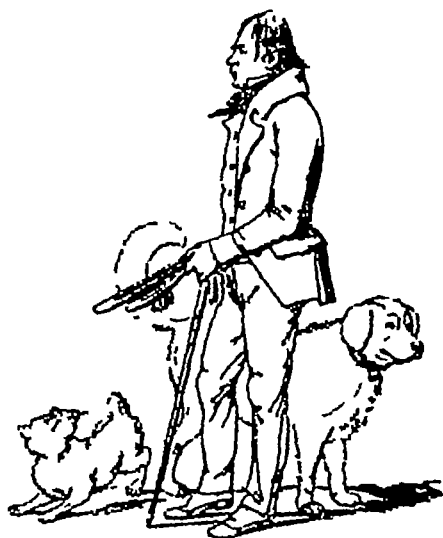
Highland sword dance, one of the traditional dances of Scotland

which he placed in Westminster Abbey

But his rule was unpopular the Scottish champion, William WALLACE, led his countrymen against the English and when Wallace was betrayed and killed, Robert BRUCE seized the Scottish crown After a long struggle he defeated the English in 1314 at Bannockburn Scotland had regained its independence Then, in 1603, on the death of Queen Elizabeth, her cousin, James VI of Scotland (son of Mary Stuart), became king also of England (see JAMES I) and so at last "Great Britain" was one kingdom In 1707 the Parliaments of the two countries were united, the united Parliament meeting at Westminster

But although Scotland was incorporated in the United Kingdom in 1707, it still retains many of its own legal customs, and has a separate department in the British Government It also retains its own national costume and dances

SCOTT, Walter, Sir (1771-1832)
Always an enthusiast for antiquities, Scott's first publication was the *Border Minstrelsy*, his collection of ballads In 1805 was published his first romantic narrative poem, *The Lay of the Last Minstrel* *Marmion* appeared in 1808, followed by *The Lady of the Lake* in 1810 In 1813



Scott, poet and novelist

he was offered the Poet Laureateship, but refused and, his popularity waning, he turned to the novel as a further means of expressing his interest in the past, writing anonymously the series soon to be famous as the "Waverley Novels." Between 1814 and 1819 appeared *Guy Mannering*, *Old Mortality*, *Rob Roy*, *The Heart of Midlothian* and *The Legend of Montrose*. These contain some of his best pictures of the Highlands and Highlanders which so delighted his southern readers. Later came *Ivanhoe*, *Quentin Durward* and *The Talisman*, set in the Middle Ages. *Kenilworth* deals with the reign of Queen Elizabeth



Baden-Powell, the first Scout

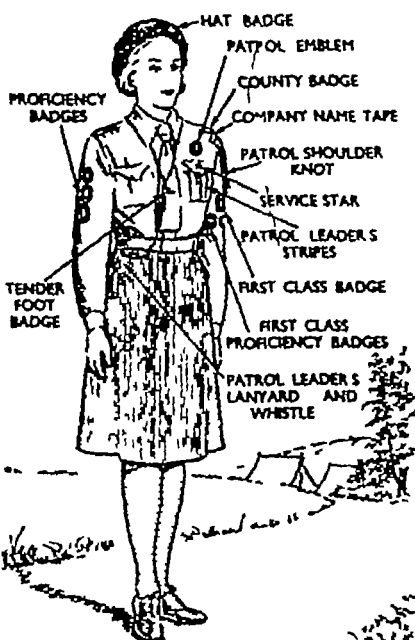
SCOUTING for boys was originated by Lord Baden-Powell, who wrote his first book on the subject in 1908. The idea caught on, and in time was expanded to include GIRL GUIDES, Wolf Cubs, Sea Scouts, Rovers, and Brownies. From Britain the movement spread to the dominions and then to foreign countries.

The Scout movement aims at making boys and girls honourable, disciplined and self-reliant.



Scouts can pass many tests

There are three degrees of efficiency—Tenderfoot, Second Class, and First Class—and there are various badges for proficiency.



Girl Guide's uniform

A scout troop is organized in patrols, each with its own leader. Its evening meetings in winter are spent in games, and in such activities as knotting, splicing, first-aid, practice in observation, and inter-patrol competitions. Sometimes the scouts stage a play or concert. At the weekends in summer such outdoor activities as nature study, tracking and CAMPING are practised. It is customary to hold a big camp, or Jamboree, every four years (in a different country each time), where scouts from all over the world gather together under canvas.

Scouts and Girl Guides have a great reputation, and are movements to which boys and girls may be proud to belong.

SCULPTURE is the art of carving from stone, wood, ivory, etc., or casting from metal, representations of human beings, animals and objects in the natural world.

The early Greeks about 700 B.C. no doubt learned their sculpture art from the Egyptians. They soon developed a set of rules of proportion and form, based upon an ideal human form inspired by the athletic men who took part in the Olympic Games and by their female counterparts. The "Discus Thrower" of Myron is one example of such idealized conceptions of bodily strength and beauty.

Greek sculpture reached its highest form in the age of Pericles and after, in the 4th and 5th centuries B.C., with such great sculptors as Praxiteles, Scopas, Polyclitus, Lysippus, and Phidias, who sculptured the beautiful statue of Pallas Athene in the Parthenon Temple at Athens.

Roman sculpture is directly descended from the Greek, in fact a great deal of it is simply reconstructed from Greek fragments.



Sculptured Discus Thrower

Later the Romans departed from the rules of form and proportion laid down by the Greeks, and their sculpture became more pictorial.

A revival of great sculpture came in the 13th and 14th centuries through the opportunities afforded by Gothic architecture to represent Christian subjects in stone for church decoration. Here we can see a return to fine form in keeping with the magnificent architecture it decorated.

Then followed the RENAISSANCE in Italy in the 15th and 16th centuries with such great names as Donatello, Michelangelo and Verrocchio, who had learnt from the Greeks. While keeping to classical proportions, they made their sculpture more human.

This great revival, however, was followed by a decline. Interest shifted from fine form to a display of clever modelling of violent movement and detail, depicting emotion.

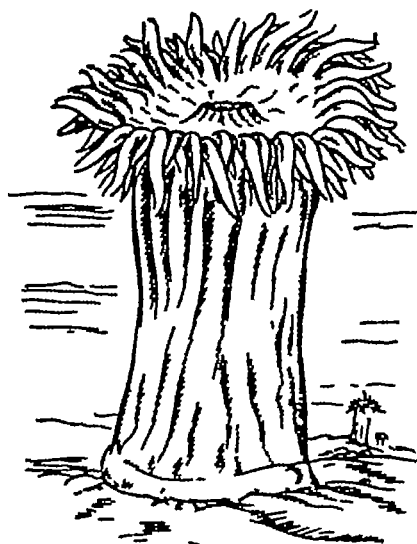
and dramatic action. This was all part of the **BAROQUE** spirit which spread through Europe during the 17th century

Although he did not belong to the Baroque period, Rodin (1840-1917), the French sculptor, was a lover of the naturalistic, and used it to express realistically the character of his subjects. Sculpture was dominated by Rodin's style till the 1920s, when it once more departed from the pictorial and returned to an art based on idealized form

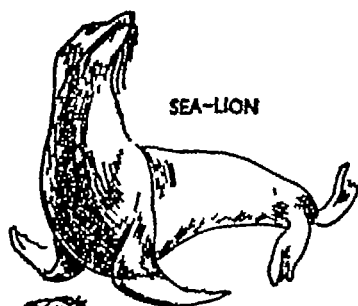
Frank Dobson, Eric Gill and the Serbian Mestrovic are typical of modern sculptors who went back to the great qualities of sculpture based on harmony of form Epstein is perhaps the greatest sculptor of modern times In some of his work, he has gone back to early primitive sculpture for simplicity, balance and strength.

SCYLLA. See **CHARYBDIS**

SEA-ANEMONE, an animal related to the **JELLYFISH** and **CORAL**. When the tide is out, anemones look like blobs of jelly, but when seen under water in pools, the



Sea-anemone, a sea animal



SEA-LION



WALRUS



SEAL

Members of the seal family

brilhan colours and the crown of tentacles surrounding the mouth are visible Sea-anemones eat shellfish and small unwary fish or shrimps

SEAGULL, a white bird with grey or black markings on the back and wings, and webbed feet Common British species are the greater black-backed gull, herring gull, common gull, and black-headed gull which is often seen by the Thames in London Most gulls nest on sea cliffs, but some winter inland

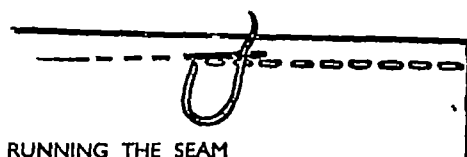
SEAL, the marine group of the **FLESH-EATING MAMMALS** Seals' limbs have, in the course of long ages, been converted into paddles for swimming They come ashore to breed in large herds, the "rookeries" Seals have their hind legs united with the tail, but sea-lions can turn their hind flippers forwards for movement on land Seal-skin fur comes from fur-seals Grey seals and common seals live off the

west coast of Britain Walruses live in the Arctic, using their huge tusks to get shellfish from the sea bottom for food

SEA-LION. See SEAL

SEAM. The type of seam to be made on a garment will depend on its purpose and on the kind of material used Fine fabrics require dainty seams Easily frayed materials will necessarily have deeper turnings All seams must be strong enough for their purpose, lie flat, and show no puckering

The *French seam* is used on lingerie, blouses, dresses, and children's wear made of thin materials



RUNNING THE SEAM



TRIMMING
EXCESS MATERIAL

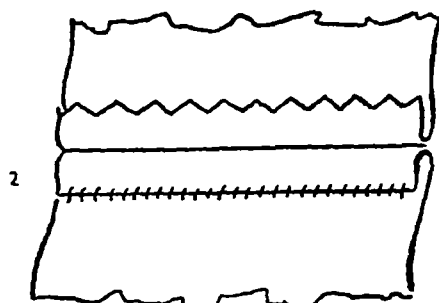
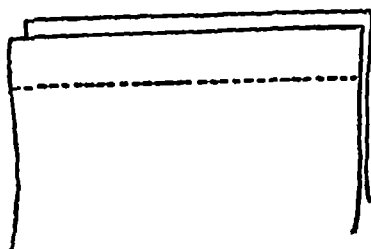


TURNED AND STITCHED

Making a French seam

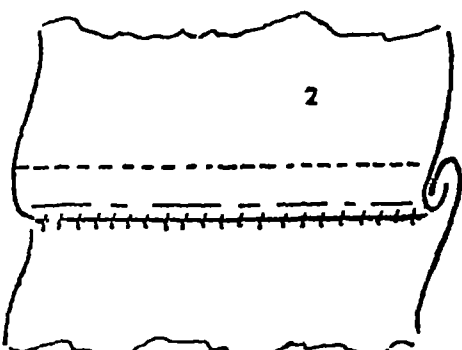
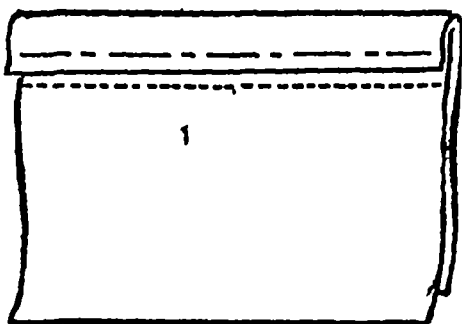
Place the wrong sides of the material together, run about $\frac{1}{4}$ inch from the edge if this is likely to fray, or $\frac{1}{8}$ inch, if not Trim the excess material Turn to the wrong side and tack, making sure that all the raw edges are enclosed, then run, and remove the tacking The seam when finished should be quite flat

The *open seam* is used on outer garments and thick materials, silks and fine woollens Place the right sides of the material together and, allowing for turnings, machine (see



Making an open seam

1) Press this seam open flat, then neaten the raw edges with overcasting or pinking (see 2) To overcast, start with BACK STITCHES, bring the needle through the front, take the thread over to the back and



Making a run and fell seam

repeat The needle should be held at right-angles to the material Finish each raw edge separately Pinking is done by cutting adjoining triangular sections out of the raw edge all along the seam This is suitable only for non-fraying material

The *run and fell seam* is a strong flat seam suitable for use on underwear Place the two edges of the material together with right sides facing, so that the back edge is $\frac{1}{4}$ inch above the front edge Tack, then run or machine Turn down the back edge over the front and form the HEM Tack (see 1) Now pull out the back piece of material, and fold forward the seam just made Tack it down, then hem or machine all the way along (see 2) When complete, the seam must be quite flat

SEA-SERPENT. Stories of the sea-serpent, an enormous marine reptile, have been told throughout history, but no real proof of its existence has yet been given

SEASONS OF THE CHURCH

These are—*Advent* the coming of Christ, *Christmas* the birth of Christ, *Epiphany* Christ manifested to the Magi; *Ash Wednesday* first day of Lent and a day of special public sorrow for sin, *Lent* the temptation of Jesus in the wilderness and fasting, *Palm Sunday* the entry of Christ into Jerusalem, *Maundy Thursday* the Last Supper, *Good Friday* the trial and Crucifixion, *Easter Day* the Resurrection, *Ascension Day* the Ascension into Heaven, *Whit Sunday* the coming of the Holy Spirit, *Trinity Sunday* the Trinity

SECANT. See CIRCLE

SECOND WORLD WAR.

See WORLD WAR (SECOND)

SECTOR See CIRCLE

SEED. When an ovule within a flower ovary has been fertilized by

a pollen grain, it develops into a seed (see FLOWER and FRUIT) from which a new plant can be grown Food for growth is passed from the parent plant to the seed through the seed-stalk

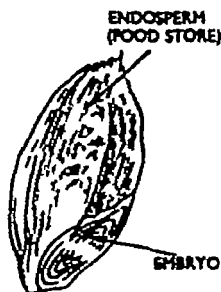
When the seed is free of the parent plant and is in contact with the earth, within the seed-coat or testa the embryo develops its tiny shoot and root, the plumule and radicle, and one or two cotyledons



2 COTYLEDONS SEPARATED TO SHOW YOUNG SHOOT A, AND YOUNG ROOT B BETWEEN THEM

Seed outside and inside

or seed-leaves These may store food, in which case the seed will be large as in the pea or horse chestnut Food may alternatively be stored in a part called the endosperm, as in CEREALS Here the embryo, containing valuable vitamins, is often called the germ (e.g. in wheat) Every seed carries certain of the characteristics of its parent plant See GERMINATION



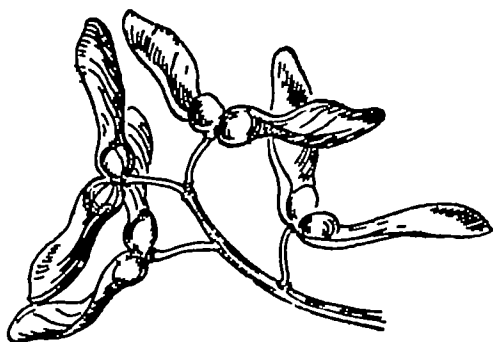
Cereal seed

Some seeds inside the FRUIT may be wind-spread as the fruit sways, e.g. from poppy heads Some fruits have wings or plumes

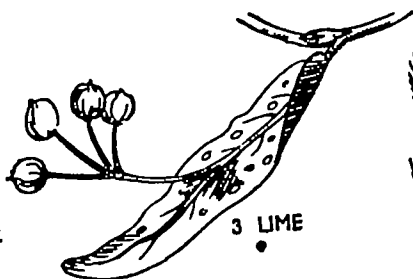
WIND SCATTERED



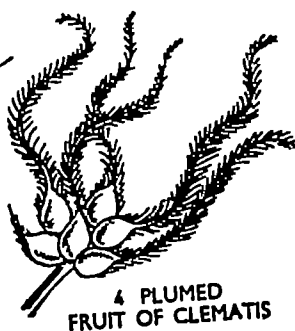
1 ELM



2 MAPLE



3 LIME



4 PLUMED
FRUIT OF CLEMATIS



5 DANDELION

6 WINGED
SEED OF
PINE FROM
CONE

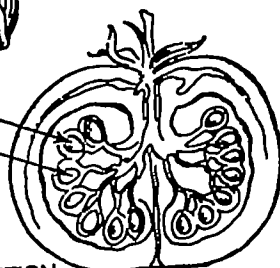


DISPERSED BY ANIMALS



7 SECTION
THROUGH
ROSE HIP

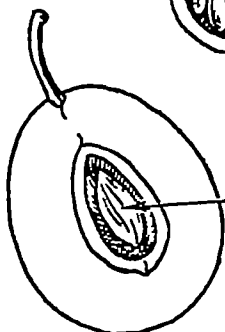
SEEDS
INSIDE
BERRY



8 SECTION
THROUGH TOMATO



9 BURR
MARIGOLD



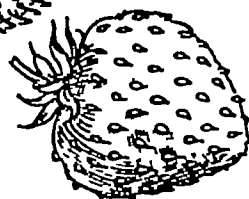
SEED
WITHIN
STONE

11 SECTION
THROUGH PLUM

10 GOOSEGRASS



12 BURDOCK



13 STRAWBERRY

Seeds of different plants are spread in different ways. Common methods are by the wind (Nos 1-6), and by passing animals (Nos. 7-13)

which catch the wind, as in maple and dandelion, or they scatter winged or plumed seeds, as do the pine and willow-herb. The walls of the fruit may grow juicy, so that birds and other animals eat plums, cherries, gooseberries, etc., and scatter the seeds. Or the fruits may grow prickles and catch on to passing animals, as do those of burdock and goosegrass. In hot sun gorse and lupin pods burst and twist suddenly, spreading seeds.

SEEDLING, a baby plant, as such, seedlings require care in order that their later life may be a healthy one. When big enough to be handled, they should be pricked out or transplanted into prepared beds to give them greater room for growth and to prevent overcrowding. Be careful to lift them from well beneath the roots so that the soil around the young roots is not disturbed more than is necessary. They should be dropped into a hole made by a dibber or small, pointed stick, and this should then be reinserted at the side and pressed over towards the seedling so that the soil is forced into contact with the roots. Soil should be pressed with the fingers firmly around the base of the plants. See **GERMINATION**.

SEED-SOWING. The most common method of plant PROPAGATION is by the sowing of SEED.

Generally in sowing seeds the smaller the seeds the less will be the quantity of soil needed to cover them. Very tiny seeds can be scattered and merely raked over after sowing. Slightly larger seeds should be sown in drills which are made by stretching a line along the ground and then drawing the point of a draw hoe along the line. Drills should be from $\frac{1}{4}$ inch to 1 inch deep. When the seeds are sown they can be covered by lightly pulling the soil over them with a hoe or rake. See **GARDEN TOOLS**.

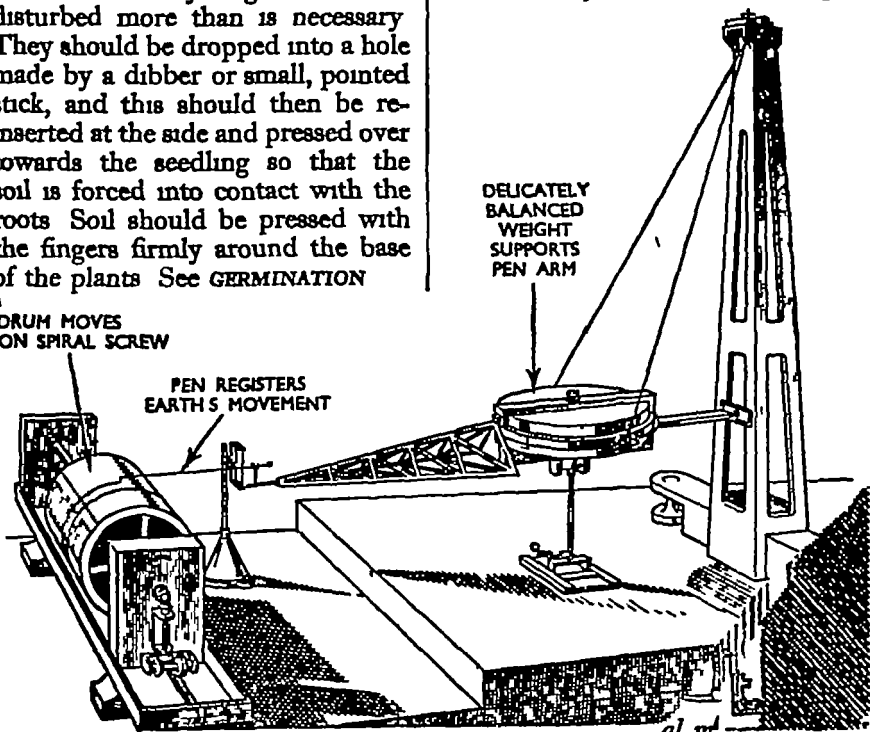
SEGMENT See **CIRCLE**.

SEISMOGRAPH, an apparatus to detect earth tremors. It consists essentially of a pen carried on a heavy pendulum or weight which is delicately balanced. The pen

DELICATELY
BALANCED
WEIGHT
SUPPORTS
PEN ARM

DRUM MOVES
ON SPIRAL SCREW

PEN REGISTERS
EARTH'S MOVEMENT



Seismograph for registering earthquake shocks

point is touching paper rolled around a cylinder, the cylinder is made to revolve continuously and very slowly, and any unusual shaking of the earth affects the delicately balanced pen and is registered on the paper See EARTHQUAKE

SELENIUM is a metallic ELEMENT whose most useful property is that it becomes a conductor of electricity when light falls on it It is used in certain types of PHOTO-ELECTRIC CELL

SENATE is the name given to the Upper House in countries which have no peerage to form such a house in the Legislature, as in the U S A and some Dominions These Senates are elected

SENSES, the organs with which a person or animal becomes aware of the outside world Each sense organ is receptive to a particular kind of stimulus, and sends messages to the brain by means of nerves The eye is the organ of sight, the ear of hearing and balance, the skin surface of touch, the tongue of taste, and part of the nose of smell The relative importance of senses varies, human beings depend chiefly on sight and very little on smell, on which dogs largely rely Some animals have sense organs placed differently from ours, e g insects smell with their antennae, while grasshoppers have their ears in their hind-legs.

Touch is most acute at the finger-tips, lips and tongue It is felt when hairs are moved (especially animals' whiskers), since touch hairs are present at hair bases minute touch organ, and the nerve-endings in the skin heat, cold and pain, join

11 SECTION passing to the brain THROUGH PLUM te are closely linked.

Seeds of different are set microscopic by the wi. at the tip are and salt, at the

sides to salt and sour, and at the back to bitter The parts of the nose sensitive to smells are two square-inch areas of skin high up in the nasal passages Scented particles reach these as air is breathed in, or from food in the mouth See also EAR, EYE, NERVOUS SYSTEM

SENTENCE. See GRAMMAR and SYNTAX

SERENADE, at first the evening song sung by a lover outside the window of his beloved one, it now often means a piece of instrumental music in song form

SERIES. A mathematical series is a sequence of numbers or terms, in which each term in the series is derived from those preceding by some rule or law In the series of natural numbers. 0, 1, 2, 3, 4, 5, 6, etc, each number is derived from the previous number by adding 1 to it The series can be continued backwards by subtracting one 4, 3, 2, 1, 0, -1, -2, -3, etc The series of even numbers is formed by continually adding or subtracting 2 2, 4, 6, 8, etc or 6, 4, 2, 0, -2, -4, etc A series formed by continually adding or subtracting the same quantity is called an *arithmetical progression* The quantity added or subtracted is called the *common difference* (when we subtract, the common difference is negative, minus). Here are some examples

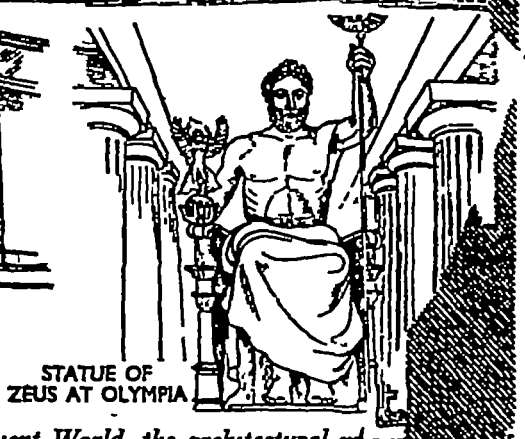
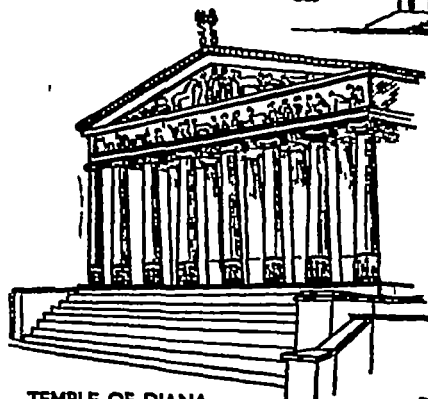
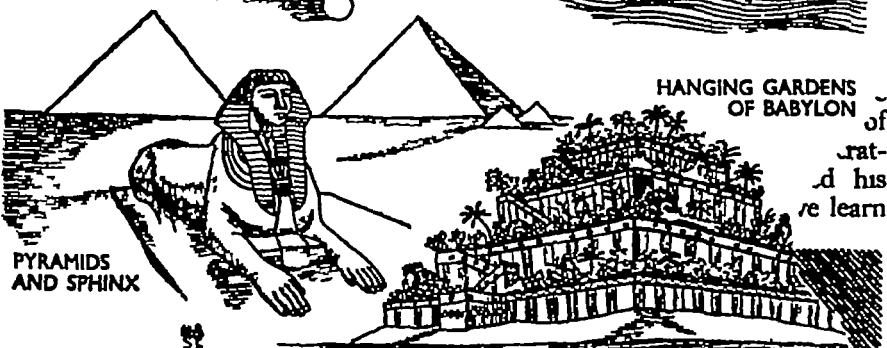
(Common difference 3). 7, 10, 13, 16, 19, 22, etc

(Common difference $2\frac{1}{2}$) 4, $6\frac{1}{2}$, $8\frac{1}{2}$, $10\frac{1}{2}$, 13, $15\frac{1}{2}$, etc

(Common difference -5) 16, 11, 6, 1, -4, -9, -14, etc

(1st term a , common difference d) a , $a + d$, $a + 2d$, $a + 3d$, etc The number of d 's is always one less than the number of terms, so the n th term is $a + (n - 1) d$

A *geometrical progression* is formed by multiplying each term of a series by a number (the *common*



*The Seven Wonders of the Ancient World, the architectural m—
were so admired and talked about by people of those days try's days*

ratio) to form the next term Here are some examples

(First term 2, common ratio 3)
2, 2×3 , 2×3^2 , etc, or 2, 6, 18, 54, etc

(First term 3, common ratio -2)
3, $3 \times (-2)$, $3 \times (-2)^2$, etc, or 3, -6 , 12, -24 , etc

(First term a , common ratio r)
 a , ar , ar^2 , ar^3 , etc The number of r 's is one less than the number of the terms, so the n th term is ar^{n-1}

(First term a , common ratio $-r$)
 a , $-ar$, ar^2 , $-ar^3$, ar^4 , etc

The terms are alternately $+$ and $-$ The n th term is $a(-r)^{n-1}$. This term is $+$ if $n-1$ is even, and $-$ if $n-1$ is odd

To find the common ratio we have only to divide any term by the previous term Thus for 7, 28, 112,

448, etc., the common ratio will be $\frac{28}{7}$ or $\frac{112}{28}$ or $\frac{448}{112}$, etc. $= 4$

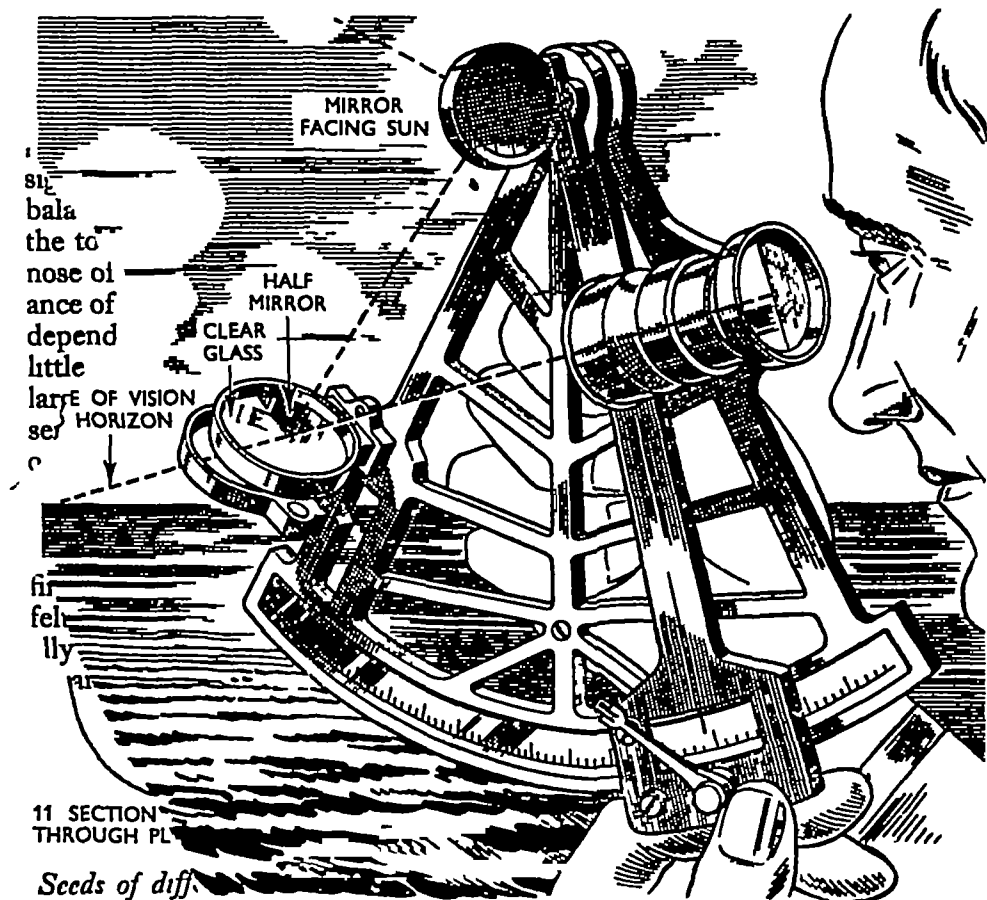
We can form mathematical series in many ways Here are some examples where the method of forming any term from the previous term is obvious—more terms can readily be added when the method is found

(a) 2, 6, 12, 20, 30, 42, etc

This may be seen to be 1×2 , 2×3 , 3×4 , etc, or we may see it as $0 + 2 = 2$, $2 + 4 = 6$, $6 + 6 = 12$, $12 + 8 = 20$, etc with the difference increasing by 2 each time

(b) 0, 1, 4, 9, 16, 25, 36, 49, etc,
i.e. 0^2 , 1^2 , 2^2 , 3^2 , 4^2 , 5^2 , 6^2 , 7^2 , etc

(c) $\frac{1}{1}$ $\frac{1}{2}$ $\frac{1}{3}$ $\frac{1}{4}$ $\frac{1}{5}$ $\frac{1}{6}$ $\frac{1}{7}$ $\frac{1}{8}$, etc



11 SECTION THROUGH PL

Seeds of diff. by th ant determining a ship's latitude from the sun's height

SEVEN WONDERS OF THE ANCIENT WORLD, the buildings and monuments most popular with travellers and story-tellers in the ANCIENT WORLD. They are all shown in the illustration on p 519. They have all crumbled and disappeared with the exception of the SPHINX and PYRAMIDS of Egypt.

SEX differences are the attributes which distinguish male from female living things, especially those concerned with FERTILIZATION—the creation of new life.

SEXTANT. To find the latitude of a ship at sea it is necessary to be able to measure the exact angular height of the sun above the horizon at a known time of the day. The instrument used for this is the sextant. The telescope is pointed directly at the horizon, and the mirror on the movable arm is revolved until it reflects the sun's light on to the half mirror, from which the rays also pass into the telescope. The scale at the end of the arm gives a reading from which the angle of the elevation or height of the sun can be ascertained.

SEYCHELLES. See MAURITIUS.

SHAFTESBURY, Earl of (1801–1885) Anthony Ashley Cooper, the 7th Earl of Shaftesbury, devoted his life to helping the poor and weak, especially the children.

The early years of the 19th century were an unhappy time for poor children. Little climbing-boys were sent up the twisting chimneys to sweep down the soot with brushes, bruising and scraping their joints, and sometimes getting suffocated. In mills, small boys and girls crouched under machines,

piecing broken threads. In coal mines, boys and girls dragged tubs of coal along dark underground passages, then there were the waifs in big cities, homeless and friendless, living by begging, and sleeping in archways. All these children found a friend in the good Earl.

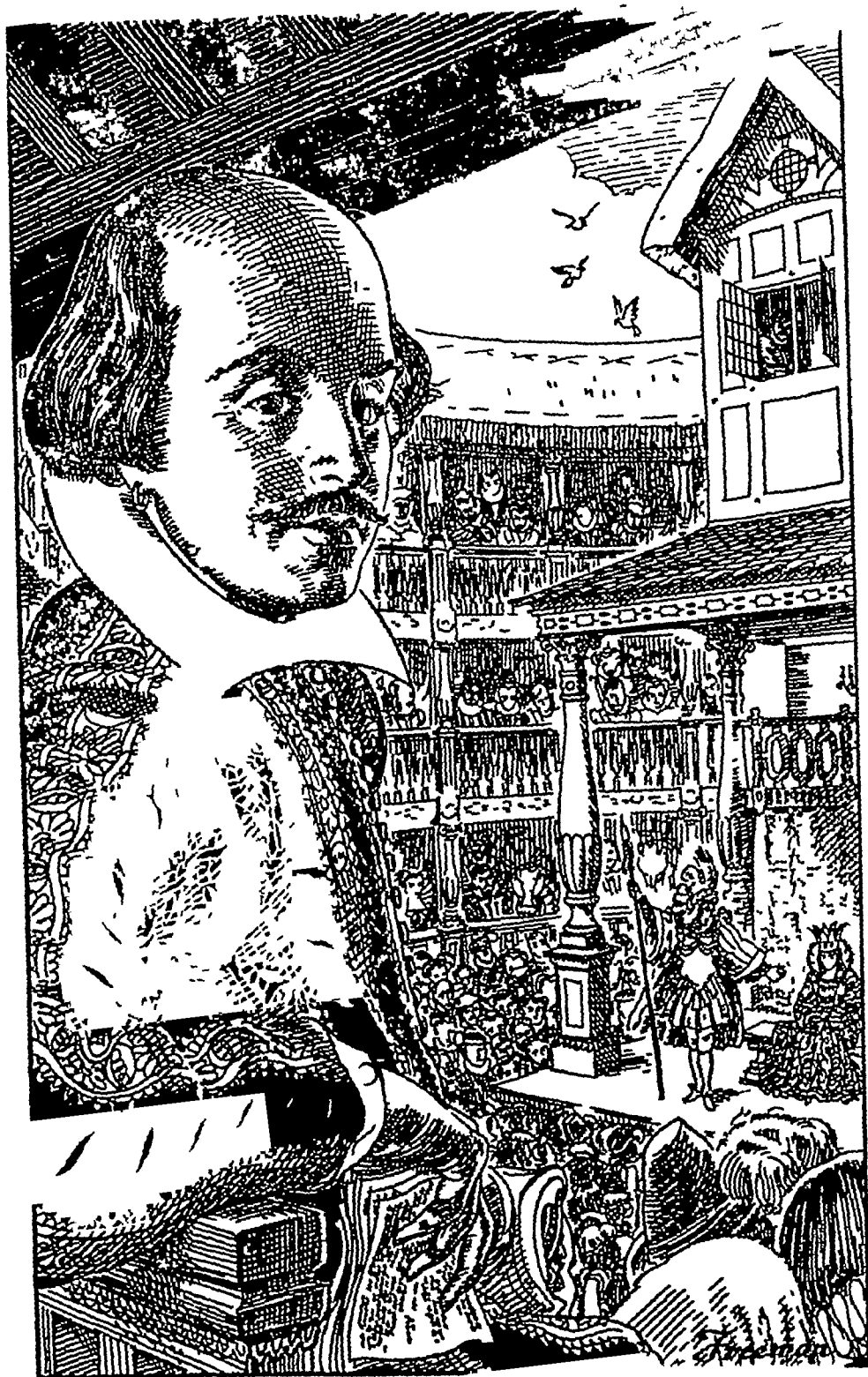
By his work in Parliament, he managed to get shorter hours for children in some industries, and the abolition of child labour in others.

SHAKESPEARE, William (1564–1616), was born at Stratford-on-Avon, the son of John Shakespeare and Mary Arden. His family was of some importance in Stratford, his father being a prosperous merchant. Little is known for certain about his life beyond that he married Anne Hathaway in 1582, and that they had three children—Susannah, and the twins, Hamnet and Judith.

As a boy he no doubt saw the plays put on by the troupes of wandering actors who visited Stratford. These must have fired his imagination, for, by 1592, we learn



Chimney boy of Shaftesbury's days



Shakespeare wrote his plays for a stage very different from that of today—the audience surrounded it on three sides, and it had no scenery

that he had gone to London and was earning a living in the theatre. By 1594 he was a member of the Lord Chamberlain's company of actors, the best in London, where his main work was to write plays for the players to put on.

The theatre in England at this time was like a new invention. Those who made up the plays usually turned to history or to earlier literature for stories to make into stage dramas. Shakespeare was very good at this. Like most of the others, he found his plots in old stories, but in using them he improved them out of all recognition. He wrote quickly, turning out about a couple of new plays a year and revising others, and they made him famous and wealthy.

In 1597 he bought a fine house in Stratford to which he meant to retire, and he did so in 1610.

Shakespeare's plays are very different from those of the modern stage. Like Christopher MARLOWE, he wrote most of his work in blank verse (see POETRY). This meant that conversation in his plays could not be entirely natural, but this disadvantage is counterbalanced by the power of poetry to express moments full of drama and passion. What is more, Shakespeare was writing for a stage that was simply a large platform jutting from the end wall towards the centre of the audience (see DRAMA and the THEATRE). On such a stage scenery could not be used. The characters themselves had to conjure up the scene. And, poetry can do this better than prose.

"This castle hath a pleasant seat
the air

Nimble and sweetly recom-
mends itself

Unto our gentle senses "

It is impossible to explain in a few words why Shakespeare is outstanding in English literature, but

here are a few indications of the wide scope of his genius.

(1) He is first a poet. You can take innumerable passages from the mouths of his characters and recite them as magnificent poetry.

(2) He is a writer of comedies of which many count *Twelfth Night* as being the most broadly humorous, and *As You Like It* the most poetic and imaginative, of all English comedies. *A Midsummer Night's Dream* is a delightful combination of robust humour and fairy tale.

(3) He is a writer of historical plays such as *Richard II* and *Henry V*. These, though not very accurate as history, helped his countrymen to understand the spirit of their own past. They dramatize bygone forces and personalities and helped to shape the spirit in which his countrymen faced their future.

(4) He is a writer of tragedies. In them, Shakespeare's poetry carries



Scene from Shakespeare's play, "*A Midsummer Night's Dream*"



"Romeo and Juliet" performed before a modern audience

a load of human emotion, which gives us much to reflect upon. He shows us the intensities of young lovers' joys and griefs in *Romeo and Juliet*, the dilemma of a *Hamlet*, the ruthless ambition of a *Lady Macbeth*, the broken heart of old *King Lear*, the passion and intrigue of *Antony and Cleopatra*.

(5) He is astonishingly diverse both in the range of his subjects and in the range of the people he creates. Think of the Shakespeare plays you have read or seen. Remember the trappings, the swords, the battlements and the battles, the ships and shipwrecks, the camps and halls, the gaily dressed lords and ladies, the grim warriors, the girls disguised as boys, the distant journeys, the desert island, the witches and their brew, the murderers and their murdered men, the spectres and the skulls, the spirits of the air—what a wonderfully *romantic* mixture it all is, and how great a writer he would

be, even if there were only this surface diversity. But there is depth as well, and thus you may explore and recognize as you grow older.

SHANTY, a sailors' song of the old sailing-ship days. The shanty man sang the verses, the crew joined in the choruses and the rhythm of the song helped to get the necessary timing for a special effort, like hauling a rope or pushing a capstan. Although no longer sung by ships' crews, shanties are often heard sung in concerts or on the wireless, some are sad, while others are very jolly.

SHARE. Shares are simply investments made by individuals in the **CAPITAL** of a **COMPANY**, by which each owns a share or portion of the company. If a company has a capital of £1,000 divided into £1 shares, then the person who owns a £1 share is the owner of a $\frac{1}{1000}$ th part of the company. Shares can be bought and sold in a special market, the **STOCK EXCHANGE**, through

special agents known as stock brokers. The *nominal* value of £1 share would be £1, but if the company made large profits, then the *market* value of the shares would rise, for shareholders would receive a larger *DIVIDEND* on their shares. If the company made a loss then the market value would fall. When shares or stocks are bought and sold on the Stock Exchange, they are bought and sold at their market value. These prices are quoted in the Press.

Stocks are similar to shares if a company has, say, £1,000 capital divided into £100 stock, then the holder of £100 stock will own a 1/10th of the company. Like shares, stocks are bought and sold on the Stock Exchange, and their market value will vary with the success or failure of the company's trading activities.

SHARK, and the allied dogfish and ray, are marine fish with a skeleton of cartilage (gristle) and not bone, and fleshy fins. Very many

kinds are known, from the three- or four-foot spotted dogfish and rough-hound which damage herring in fishing nets off the coasts, to the ferocious tiger shark and the more harmless basking shark and whale shark of tropical seas. These grow up to fifty feet long. Rays and skate are flattened, adapted to live on the sea bottom. Some have a poisonous spine on the long tail. Giant rays, which can measure twenty-two feet across, swim in surface waters in the tropics.

SHAW, George Bernard (born 1856), came to London from Dublin in 1876, and as a member of the Fabian Society wrote political pamphlets, later he worked as a journalist, music and dramatic critic. His first play was *Widowers' Houses*. *Plays, Pleasant and Unpleasant* included *The Philanderer*, *Arms and the Man*, and *Candida*.

There followed *Three Plays for Puritans* including *Caesar and Cleopatra*, and *Man and Superman* which expounds his philosophy of the Life Force, an idea elaborated in *Heartbreak House* and *Back to Methuselah*. A particularly effective and popular work is *Saint Joan*. On Joan of Arc. Plays on political themes include *The Apple Cart* and *Geneva*.

His non-dramatic works include the important *Prefaces* to the plays and *The Intelligent Woman's Guide to Socialism and Capitalism*.

Shaw is a moralist with ready opinions as to right and wrong in many spheres. A serious Irish social revolutionary, and the most nimble-witted of thinkers, he is a believer in the power of thought, and has held it worth while to make his plays the vehicles of his ideas. His ideas have dramatic power because they are opposed to many still-prevailing values. And because he is a born dramatist, his success has



Scene from "Antony and Cleopatra"



Bernard Shaw, socialist and dramatist

been great. He is perhaps the only dramatist in English whose characters hold us at least as much by what they think and say as by what they are and do.

SHEEP. See DOMESTIC ANIMALS.

SHELLAC is a hard resin produced on the bark of trees by an insect. It dissolves in alcohol and is used for varnishes and electrical insulation.

SHELLEY, Percy Bysshe (1792-1822), was the poet son of an aristocratic and conventional family.

In 1816 appeared "Alastor," the first work to show his qualities as a poet. Among the working-class of those days unemployment and acute poverty were widespread, and Shelley, working for the immediate

relief of the destitute, wrote shortly afterwards the *Revolt of Islam*, an expression of his revolutionary ardour. About this time, too, his wife, with whom he had quarrelled, died in unfortunate circumstances. This brought him much public criticism and disapproval. He married again, and left England for Italy.

Yet Shelley was no villain. He was an idealist at odds with existing conventions and ready to act in accordance with his principles. "Prometheus Unbound," written at Rome in 1819, is the noblest expression of Shelley's creed, a poem in which he takes the legend of Prometheus and Jupiter, and treats it as a symbol of the oppres-

sion of man and his release into a world made perfect by his triumph over his oppressors.

In Pisa, he wrote the "Ode to the West Wind," "To a Skylark" and "The Cloud." Keats's death occasioned "Adonais," an elegy.

In 1821 his *Defence of Poetry*, a prose work, sets forth his view of the poet as a prophet among men. Shelley, like Keats and Byron, had an untimely death. His sailing boat capsized in a sudden squall. His body was cremated on the shore and the ashes buried in the cemetery in Rome next to Keats. His notable poems include "Hymn to Intellectual Beauty," "Mont Blanc," "Rosalind and Helen," "Stanzas written in dejection, near Naples," "Witch

of Atlas," and "Hymn to Pan"

SHERIDAN, Richard Brinsley (1751-1816), was born in Dublin, but educated in England. He came of a theatrical family, and when his father came to join Garrick at Covent Garden, the son went to Harrow.

In 1775 *The Rivals* appeared, at first it was a failure, but when a revised version was put on nine days later, it achieved success.

In 1776 Sheridan became manager of Drury Lane Theatre, where in 1777 his best comedy, *The School for Scandal*, was first acted. *The Critic*, a satire on the theatre of his time, appeared in 1779.

As well as writing for the stage, Sheridan took a leading position in Parliament.

SHERIFF. The office of sheriff was known in England before the Norman Conquest. Nowadays the

office of High Sheriff is almost an honorary office. In Scotland, however, the Sheriff, a person trained in law, is a judge of the Sheriff Court. See LAW COURT.

SHIPS and BOATS. Among the oldest known boats are the coracle and the dug-out canoe. In fair weather, a man-driven boat can be propelled in any direction. But human arms are not very powerful, and even the trireme and galley of ancient times, with rows of slaves pulling at the great oars, could not carry heavy cargo. So the trader had to make use of the steady winds which blow over large tracts of the sea at certain times of the year.

The simplest kind of sail arrangement, the square rig, was used by the Saxons, Vikings and Normans in their invasions of Britain. It consisted of one square sail set across the ship on a short stiff mast. This



Shelley lived the last years of his short life in Italy

type of rig was later expanded to many such sails on several masts, as in the tea-clipper, but the disadvantage is that with this arrangement the ship cannot make much headway against the wind

In the fore-and-aft rigged ship, of which the racing yacht and sailing dinghy are examples, the wind bounces off the sail, which is suitably set, giving the sail a push as it does so, and it is possible for a ship with this rig to sail very close to the wind

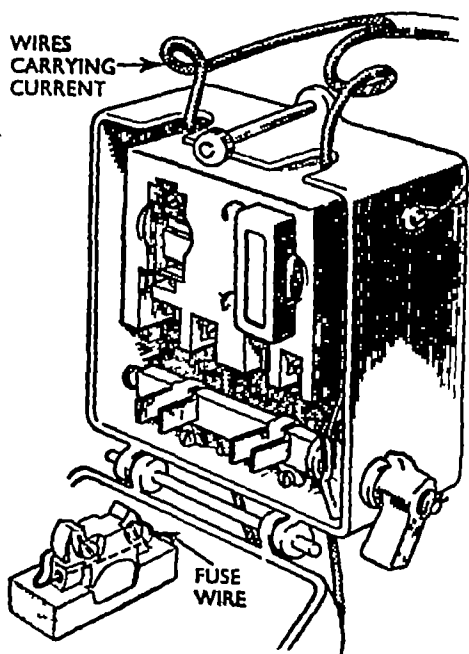
The first steamships were driven by paddle wheels worked by reciprocating ENGINES, later it was found that the screw PROPELLER was more powerful and economical for open-sea work. Now the paddle wheel is only used for slow vessels in shallow waters where a screw propeller would be damaged. The best steam engine for ships is the steam TURBINE, which is used today by naval vessels and liners. The steam-raising today is carried out by

burning oil rather than coal, as oil is easier to manage

The latest development is to use a motor, the internal combustion ENGINE, for turning the propellers small, fast naval craft and lifeboats use it. Diesel engines are used increasingly, too

SHORT CIRCUIT. The breakdown of insulation (see INSULATOR) in an electric CIRCUIT may cause a large current to pass through a shortened circuit, or the wire may get overloaded with current for other reasons, with prospect of overheating and fire. This danger is countered by the introduction of an electrical fuse at an accessible point in the circuit. A fuse is a weak point deliberately introduced, and consists of a piece of wire of low melting point, such as tin, so that, as soon as the current in the circuit rises above the safe strength, the piece of tin wire melts and breaks the circuit. This puts the circuit out of action until a new fuse wire is fitted, and, by calling attention to a defect, reduces risk of fire or other damage. The fuse wire is held in a porcelain tube to prevent anything burning when it melts. The fuse should be in an accessible place so that a burnt-out fuse wire can be replaced quickly by a new one

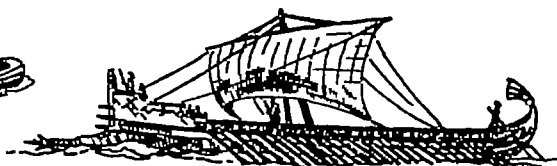
SHORTHAND is the art of writing as rapidly as one speaks, as opposed to longhand writing, where it takes time to form the letters. Curiously enough, it is not a modern idea, a method of shorthand writing was used by a friend of Cicero to record Cicero's speeches. Modern shorthand, however, began in England. From Elizabeth's reign onwards there were systems of shorthand proposed, and gradually the idea of writing according to the sounds of words became recognized. Pitman's



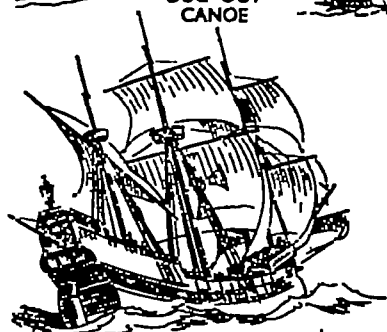
A fuse is a protection against a short circuit or too much current



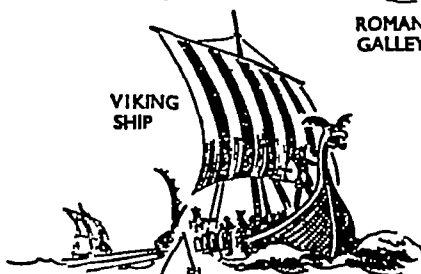
DUG-OUT
CANOE



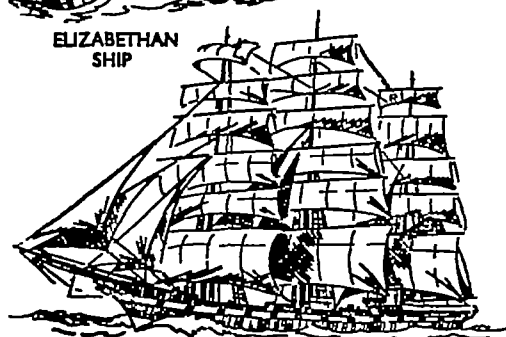
ROMAN
GALLEY



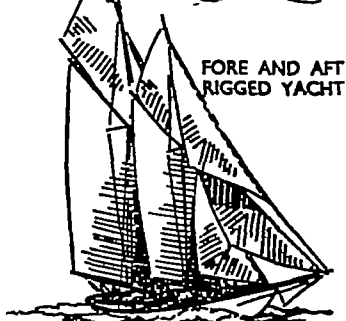
ELIZABETHAN
SHIP



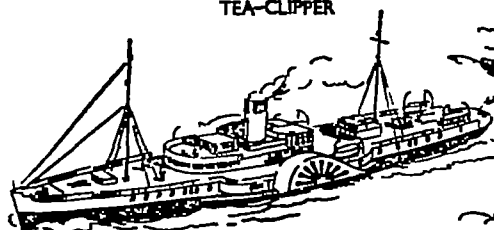
VIKING
SHIP



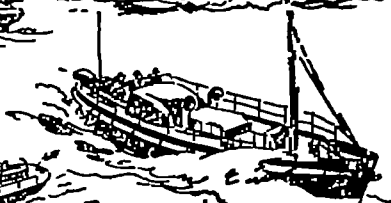
TEA-CLIPPER



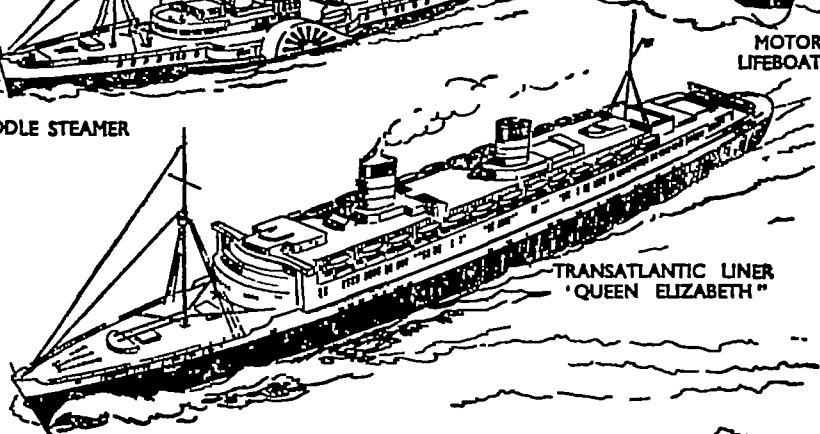
FORE AND AFT
RIGGED YACHT



PADDLE STEAMER



MOTOR
LIFEBOAT

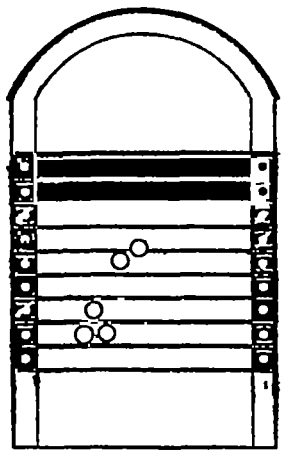


TRANSATLANTIC LINER
'QUEEN ELIZABETH'

Ships through the centuries to illustrate man's conquest of the sea

system, put forward in 1837, is based on this phonetic idea, and includes abbreviations as well. His system uses simple geometrical forms, straight lines and shallow curves. In 1888 another system, by Gregg, was published; this system is based mainly on the curve, curving motions being a feature of ordinary writing. Since then other systems have been evolved.

SHOVE HA'PENNY is a game played between two persons or teams, on a board 25 inches long by 15 broad, divided by lines into "beds" 1½ inches wide as in the diagram. The spaces at the sides



Shove Ha'penny board and disks

are for marking the score. Each player has five smooth disks the size of a halfpenny. The players toss to decide who shall go first, then the winner places his first disk with about half of it projecting over the edge of the board and strikes it with the ball of his thumb. He continues likewise with his other disks. The object is to get the disks between the lines without any overlapping, in which case they score a point each to that side for the particular beds they are in. Then the second player or team goes.

The score is marked at the side, and when one side has scored three

points for any bed, that bed is full for that particular side and they can score no more points for it. Any disks sent by one side into a bed that has already been filled by them count to the other side, this does not apply, however, if the point conceded is the last that a side needs to fill up all its beds—a final point must be won by a side, not given away by the other side. Disks not reaching the first line, or overlapping the top line or side lines are out of play and cannot be used for cannoning. The side getting all nine beds filled first wins that game. The best of three games usually decides a match. For the second game the loser of the first game starts first, for the last game (if that is necessary), players toss again to see who shall play first.

SHREW. See **INSECT-EATING MAMMALS**

SHRIMP. See **CRUSTACEANS**.

SHRUB. See **TRFE**

SIAM (Thailand) is a kingdom of south-east Asia. Its thickly forested mountains in the north are drained by the head-streams of the Menam River. The central plain of the Menam is a great rice-growing region. Rice and teak are exported from Bangkok, the capital. Tin ore is mined in the hilly isthmus joining Siam and Malaya. See map of **INDO-CHINA** of which it is a part.

SICILY is an Italian island with a hot, dry summer and mild winter, and is ideal for fruit-growing. The chief products are lemons, olives, oranges and almonds, sulphur is also found. The chief towns are Palermo, the capital, on the north coast, and Messina, on the straits separating Sicily from the mainland. See map of **ITALY**.

SIDNEY, Philip, Sir (1554–1586), was an Elizabethan poet, courtier, man of action, and a friend of Edmund SPENSER. In 1586 he fought

in the Battle of Zutphen against the Spanish. As he was dying he refused water, giving it to another wounded soldier, saying, "Thy need is greater than mine." Published after his death, his works include the series of sonnets to Lady Penelope Devereux, called *Astrophel and Stella*, a prose romance, *Aicadia*, and a critical work, *The Apologie for Poetrie*.

SIERRA LEONE is a British colony and protectorate of West Africa with a hot, unhealthy climate. Palm oil, kernels, and spices are the chief products. Some platinum, diamonds, gold, and iron ores are mined. Freetown, the capital and chief port, was in the past a centre for repatriated freed slaves. See the map of AFRICA.

SIGNATURE, in music, the symbols placed at the beginning of a composition to show the key in which it is written (Key Signature),

and the value of the beat and the number of beats to the bar (Time Signature). In the example shown, $\frac{3}{4}$ means three beats to a bar and each beat is a quarter of a whole note, i. e. it is a crotchet. The two sharps show that it is in the key of D major or its relative B minor. See also NOTATION (MUSICAL).

SIGNIFICANT FIGURES.

Suppose a length is carefully measured and found to be 4.687 inches. We call this 4-figure accuracy. 4,087,000 miles = 4,087 thousand miles. This also is 4-figure accuracy; we call the figures 4087 "significant figures"—the 000 at the end merely shows that the measurement has been made in thousands of miles. The distance of the sun is 92,800,000 miles; this is 3-figure accuracy; the measurement has been made in hundreds of thousands of miles, or to the nearest hundred thousand

0.007265 inches is 4-figure accuracy. 7 is the first significant figure. The 000 shows that the measurement has been made in 10,000ths of an inch. It claims to be true to the nearest 10,000,000th of an inch.

0.08006 has 4 significant figures. 00 merely gives the scale of the measurement, but the 00 between 8 and 6 are significant because they are actually numbers that just happen to be 0.

92,800,000 miles may be written as 92.8 million miles, and indicates clearly 3-figure accuracy. In 92,800,000 one or more of the 0's following the 8 might be significant figures which just happen to be 0, but when we put in the decimal point we stop at the last significant figure.

0.8 is 1-figure accuracy, 0.80 is 2-figure accuracy; the 0 after the 8 is a significant figure which happens to be 0. And 0.800 is a still more careful measurement to 3-figure accuracy. See APPROXIMATION.

SILHOUETTE, the shape of any form when seen as a dark mass against light, in art, a portrait, generally a profile, cut out of black paper and so named after a French politician of the 18th century.



What a silhouette looks like

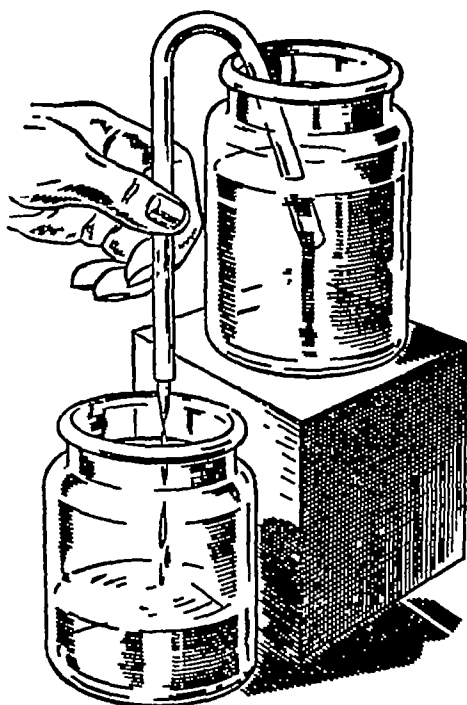
SILVER is a metallic ELEMENT which is very soft and ductile It is a good conductor of heat and electricity It is used for coins and the reflecting surfaces of mirrors, while its compounds are much used in photography

SIMILE. See IMAGERY

SIN is the breaking of God's laws as set forth in the Bible, and in the teachings of Christ Christianity teaches that all men are born with a tendency to wrongdoing, but that God's grace given through Christ can keep them from sinning

SIPHON. The true siphon is a tube used to transfer liquid from one level to a lower level over an intervening higher level The tube must first be filled with the liquid to exclude the air, and then when the upper end is put into the liquid, the liquid flows to the lower level

The "soda siphon" holds water containing the gas carbon dioxide, which rising from the water keeps



Siphoning to a lower level

it under pressure ready to push it out when the way is made clear by depressing a lever

SIRENS, in CLASSICAL MYTHOLOGY, are sea nymphs who lured sailors to their death by their sweet music

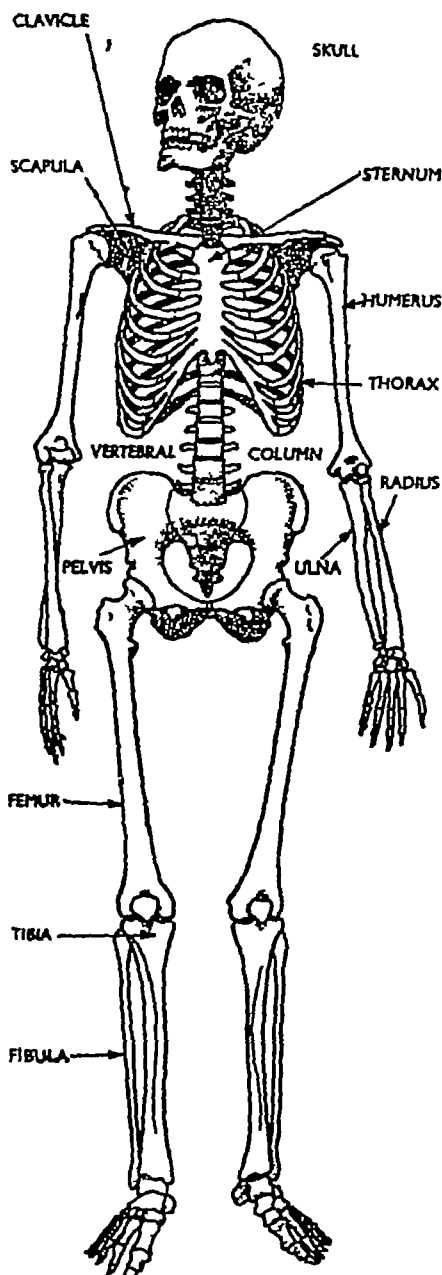
SIZE is a form of GLUE or GELATINE, used when dissolved in water to produce a smooth non-porous surface on paper or walls

SKATING can be either roller-skating on a hard rink or ice-skating on a frozen pond or ice rink The most important thing in roller-skating is balance, and this depends on confidence and practice The body is kept loose and the feet are glided in a slightly outward direction Make sure that the skates are fixed firmly When learning to skate, "scoot" along on one foot at first until balance is acquired

For ice-skating it is advisable to wear boots as the foot is balanced on a thin ridge of steel and the ankle needs extra support

SKELETON, the bony structure providing support for the body, enabling movements to be made with the aid of muscles, and protecting vital organs such as the brain, heart and lungs The skeletons of all animals with backbones are built on roughly the same plan Rabbits, birds, lizards and human beings all have a skull and vertebral column connected with both shoulders (pectoral girdle) and fore-limbs, ribs, and hip (pelvic girdle) and hind-limbs Animals without backbones may wear their skeletons on the outside and have muscles inside, as do the LOBSTER and INSECT

Bones may be joined immovably together, as are most skull bones, or be jointed together by ligaments so that movement is possible Joints are either of the hinge type (e g finger), ball and socket type (e g shoulder) or gliding type (e g

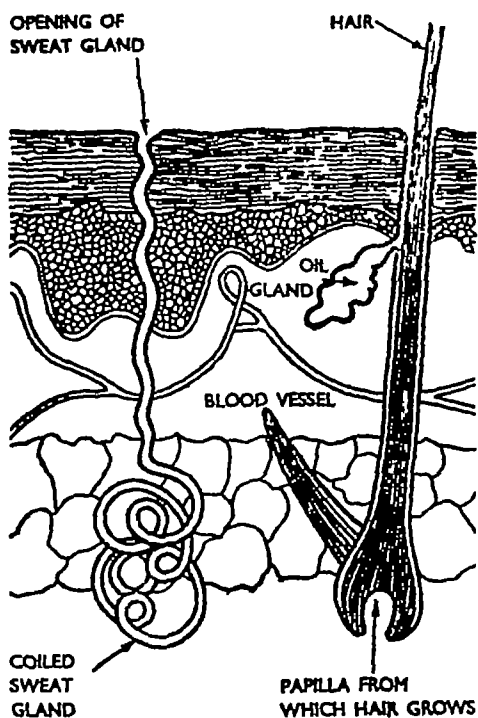


The skeleton is the bony framework of the body—the human skeleton has over two hundred bones in it, and the picture above gives the names of the most important bones. Notice the pairs of bones in the legs and arms

wrist) Cartilage (gristle) covers the bone ends at the joints, and a lubricating fluid makes them work smoothly. Bones must be strong but not too heavy, so long bones have dense bone outside, spongy bone within and marrow in the middle. The spine, a column formed of 33 vertebrae, protects the spinal cord. Between the vertebrae are disks of cartilage to prevent jarring. Several vertebrae fuse together as we grow up to form a firm support for the pelvis.

SKI-ING is both a sport and a means of travelling fast over snowy country, practised in Scandinavia, Switzerland, North America, and Russia. The skier uses skis, a type of snowshoe made of wood $4\frac{1}{2}$ inches to 6 inches wide, and from 7 to 10 feet long according to the height of the wearer.

SKIN is the protective tissue of the body forming its outer covering, and joins the mucous membrane which lines the internal cavities. Scales grow from the skin of fish and reptiles and on the legs of birds. The frog has a naked skin, the skin of birds is covered by feathers, and that of mammals generally by hair, fur, wool, bristles or spines. The human skin is made up of many layers of cells, the inner forming the dermis and the outer the epidermis. Capillaries (tiny blood vessels) carry blood in the dermis, and in it nerve endings of different types receive impulses of touch, pain and temperature (See **NERVOUS SYSTEM**). The cells at the bottom of the epidermis are alive and constantly divide to form new cells. As these pass into the upper layers, they flatten and die, finally wearing off at the surface as minute flakes. Each hair grows from a papilla which sinks into the dermis. A GLAND gives out an oily fluid into the cavity up which a hair grows, to



Structure of the human skin

keep it in good condition. A tiny muscle is attached near its base, which, when it contracts, erects the hair. Coiled sweat glands are essential to regulate human temperature. If the blood is too hot, a salt fluid (perspiration) is excreted by them. This evaporates at the skin surface, so cooling the body.

SKUNK. See **FLESH-EATING MAMMALS**

SLAVERY. From earliest times there have been records of slavery. The rise of Christianity did not put an end to the practice of keeping slaves but it resulted in their better treatment.

After the discovery of America, slaves were in great demand. To obtain the fullest benefit of the wealth of the American continent various European nations introduced large numbers of Negro slaves obtained in Africa. The first Englishman who engaged in the traffic in slaves was Sir John

Hawkins, who took part in the supplying of the Spanish settlements with slave labour. Later, in 1620, a Dutch ship from the coast of Guinea took a cargo of Negroes to Virginia and sold them to the tobacco planters. The slave trade increased until, in 1790, there were two hundred thousand Negro slaves in Virginia.

A particularly dreadful part of the slave trade was the obtaining of the Negroes. They were hunted by native chiefs who sometimes even made forays on their own subjects for the purpose of procuring slaves to exchange for European commodities.

When the conditions of slavery were understood by the British people, all that was best in them revolted against it. The first body to take definite action against the slave trade were the **QUAKERS**.

A definite step was taken when the Vice-Chancellor of Cambridge University, himself very much against slavery, offered a prize for the best essay on this subject. It was won by Thomas Clarkson for an *Essay on the Slavery and Commerce of the Human Species*. Through its publication, Clarkson met William WILBERFORCE and in 1787 a committee for the abolition of the slave trade was formed, and in 1833 an Act of Emancipation provided for the abolition of slavery throughout the British Empire.

The example of Great Britain had now been followed by many other European countries and by some American States, but the Southern States of the U.S.A., Cuba and Brazil still maintained slaves. The best intellects of America, including some politicians, showed themselves opposed to slavery. Among them were Emerson, Longfellow, and Whittier. But it was not until Harriet Beecher Stowe's book,

Uncle Tom's Cabin, appeared that the people of the Northern States of America determined that slavery must cease in the United States. The result was that a civil war broke out between the Northern and Southern States which lasted four years and eventually, in 1865, slavery was abolished, but Brazil in South America did not follow suit until 1888, and it was not until 1926 that Nepal brought the practice to an end.

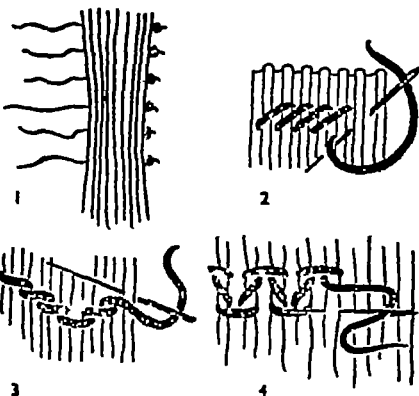
SLEEPING SICKNESS is a disease common in parts of Africa, caused by a microscopic PARASITE injected by the bite of the tsetse fly. Whole regions are made uninhabitable to man or beast by this fly, but efforts are being made to stamp it out.

SLIP STITCH is used to fasten the hems of skirts and wherever the stitching must not be visible. The needle picks up merely the surface of the single material and runs along inside the fold of the hem.

SLOTH, a South American jungle MAMMAL, which lives hanging upside down from the branches

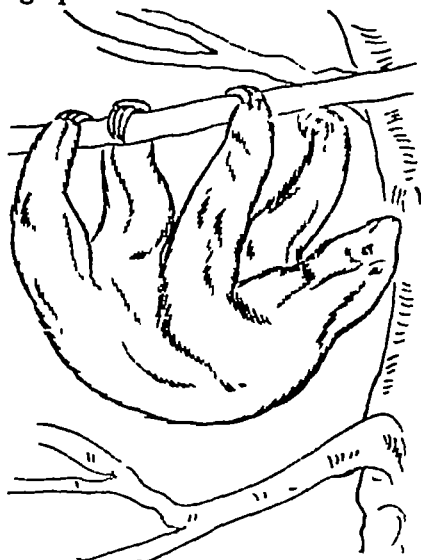
of high trees, suspended by its long, curved claws. Sloths are unintelligent, move extremely slowly and feed on leaves.

SMOCKING in dressmaking is a decorative way of holding fullness in position. It should not be attempted unless plenty of material is available, for the GATHERS should have a tube-like appearance. Allow three times as much material as required for the finished width.



Variations in smocking

Mark the material with smocking dots, using a transfer or measure with a ruler, and mark with an indelible pencil. Make a small running stitch into each dot. If the material is very thin, these holes must be transferred to the wrong side. Begin each line of running with a strong knot. When the required number of rows has been made, each line of thread is drawn up, and the end wound round a pin (see 1). The drawing up should be such that the tubes are quite compact but distinct, they should not be so tight that the subsequent stitching will be difficult. The work is now ready for decorating. Some of the stitches used are **STEM STITCH** (see 2), **chevron stitch** (see 3), and **surface honey-combing** (see 4). The completed smocking



Sloth hanging upside-down

is set into a band in the same way as **GATHERS**

SMOKE is the fine particles of ash and unburned fuel which ascend with the hot air when a fire is burning. A smoke screen is a cloud of smoke deliberately created to conceal important targets from observation. It is sometimes produced by burning heavy waste oil in special lamps. The word "smoke" is also applied to certain poison gases which consist of clouds of tiny solid particles.

SMUGGLING is getting goods into or out of a country secretly so as to evade payment of customs duties. From the 14th century action has been taken against smugglers, and a large number of Acts of Parliament have been passed in connexion with their offence.

Smuggled goods and the vessels which engage in smuggling are liable to forfeiture. Their owners may be fined heavily. Any attempt at an evasion of customs duties is punishable by the payment of a fine. Heavier penalties are enforced if any resistance is offered to customs officers while doing their duty.



Smuggling in the 18th century

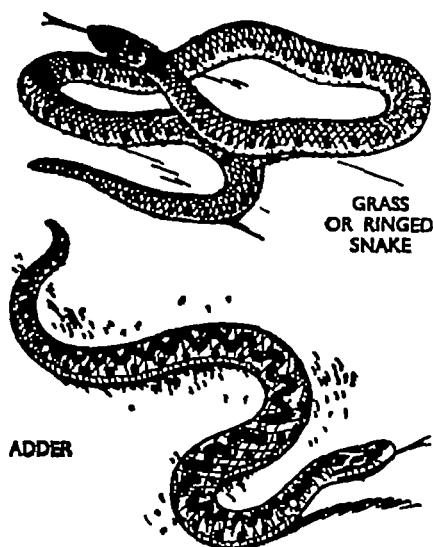
SNAIL. See **MOLLUSCS.**

SNAKE, the name of **REPTILES** without legs. The halves of the lower jaw can be moved separately, and the mouth opened widely enough to swallow prey larger than the head. The eyes have no lids, the forked tongue continually flickers in and out, as it is used for feeling. The whole skin is **MOULTED** at intervals.

Poisonous snakes have certain teeth grooved or hollow, connected with poison glands, and a snake bite may cause death. The adder is the only poisonous British snake. It is shorter (seldom reaching two feet) and thicker than the harmless grass snake, which is often killed when mistaken for an adder. Adders have a V or X mark on the head, and a black zigzag or diamond pattern down the back. The body colour varies greatly. Adders like to bask in the sun on moorland, but grass snakes (harmless) prefer damp places, often swimming to catch frogs. They have a yellow collar marking, and may reach four feet in length. Both snakes **HIBERNATE**.

The rattlesnake is a poisonous American snake, whose tail rattle is formed from dry parts which remain there each time the skin is moulted. Pythons and boa-constrictors are snakes which curl round and crush their prey. They may reach thirty feet in length, and eat animals of goat size. They can fast many months after a meal. Cobras are poisonous snakes of the East which can rear up and form a hood by spreading out the sides of the neck. In India, snake-charmers train cobras to sway to the music of their pipes.

SOAP. If a fat or oil is combined with caustic soda or potash, two products are formed—**GLYCERINE** and soap. The fat may be tallow or



Two snakes found in Britain

linseed, cottonseed, palm, olive, coco-nut, etc. The actual manufacture is carried out in huge "kettles," each holding perhaps many tons of the liquid and heated by steam. The pure soap rises to the top, and is run off to cool and harden. It may be mixed with soda or other materials before being finally made into bars.

Toilet soap is usually pure soap which has been dried, scented, and moulded by pressure.

SOCIALISM. Robert Owen, a Welshman, who set up cotton mills at New Lanark on the Clyde in 1801, is sometimes called the father of British socialism. He believed that the evils of the industrial system were due to the desire for wealth which led manufacturers to think of their own profits without consideration for the welfare of their workers. He therefore gave his employees very favourable working conditions and stood for co-operative enterprises rather than individual competition. His ideas largely inspired the CO-OPERATIVE movement which began in Rochdale in 1844.

The essence of the socialist belief today is that all wealth in the sense of land, mines, factories, banks, railways and all large-scale undertakings should be owned, not by individual shareholders, but by the people as a whole. That is, it should be nationalized or socialized and managed on behalf of the public by managers appointed by Parliament. Privately owned wealth should be restricted to such possessions as we can use up ourselves, namely, personal possessions such as clothes, furniture, motor-cars, tools, and gardens. See also COMMUNISM.

SOCIAL SERVICES are those which a state provides, through its central government and local authorities, to improve the life of its citizens in matters of education, housing, health, unemployment benefit, old age pensions, public assistance, and conditions of labour in works and factories. The 19th and 20th centuries have seen a great increase in social legislation in all countries.

SOCIETY OF FRIENDS

See FRIENDS (SOCIETY OF)

SODA (sodium carbonate) is a most important chemical, in white crystals or powder, produced nowadays from salt and ammonium carbonate in large quantities. It has a wide range of uses.

SODIUM is a soft silvery METAL which tarnishes rapidly and attacks water vigorously to form caustic soda and hydrogen. It melts at a low temperature. Owing to its chemical activity it is used in chemical analysis and preparations. Its compounds are widely used in industry; the commonest are sodium chloride—common salt, sodium carbonate—SODA, sodium stearate and oleate—soap, sodium hypochlorite—bleaching liquid, sodium sulphate—Glauber's salt, sodium

nitrate—Chile saltpetre, sodium bicarbonate—the main constituent of baking powder

SOIL covers much of the land surface of the earth and is composed of material broken down from the original rocks of the earth's crust (inorganic matter), mixed up with the decayed remains of plants, insects and everything else which has had life (organic matter) Plant life is founded in this mixture, and derives its food from it See **COMPOST**, **FERTILIZERS**, **HUMUS**

SOIL STERILIZATION is the killing of germs and pests in the soil by baking or scalding it The soil must, of course, be allowed to cool off before anything is planted in it

SOLAR SYSTEM, the system of **PLANETS** revolving round the **SUN**

SOLOMON became King of Israel after his father **DAVID** He had such a reputation for wisdom, that the Queen of Sheba came from Africa to see him He built the first Jewish temple, which took twenty years to finish, and is the traditional author of a book of the Old Testament called the *Proverbs* as well as the *Song of Solomon*

SOLOMON ISLANDS. See **PACIFIC OCEAN**

SOLUTION and **SOLVENT**. Sugar mixed with warm water quickly disappears it is dissolved Its molecules spread throughout the body of the water, its solvent If more sugar is added the same process follows until finally the water is saturated and no more sugar will dissolve Liquids as well as solids will sometimes dissolve in other liquids, e g alcohol in water Gases, too, dissolve in water, e g carbon dioxide to form "mineral waters"

SOLVENT. See previous entry, **SOLUTION AND SOLVENT**.

SOMALILAND is a broad strip round the East Africa coast formerly divided into Italian, British and French Somaliland (capitals Mogadishu, Berbera and Jibuti) It is mainly inhabited by some **NOMAD** African tribes with herds of sheep, cattle and camels Maize and millet are grown in some areas Jibuti in French Somaliland is the chief port See the map of **AFRICA**

SONATA. See **FORM IN MUSIC**
SONG, verses of poetry set to music Usually the music is repeated for each new verse, but sometimes, as with Schubert, the music is different throughout and follows the mood of the words

SOOT is a form of carbon produced when coal or oil is burned in air insufficient for complete combustion It is a greasy powder or flake and contains oil and nitrogen compounds in addition to carbon

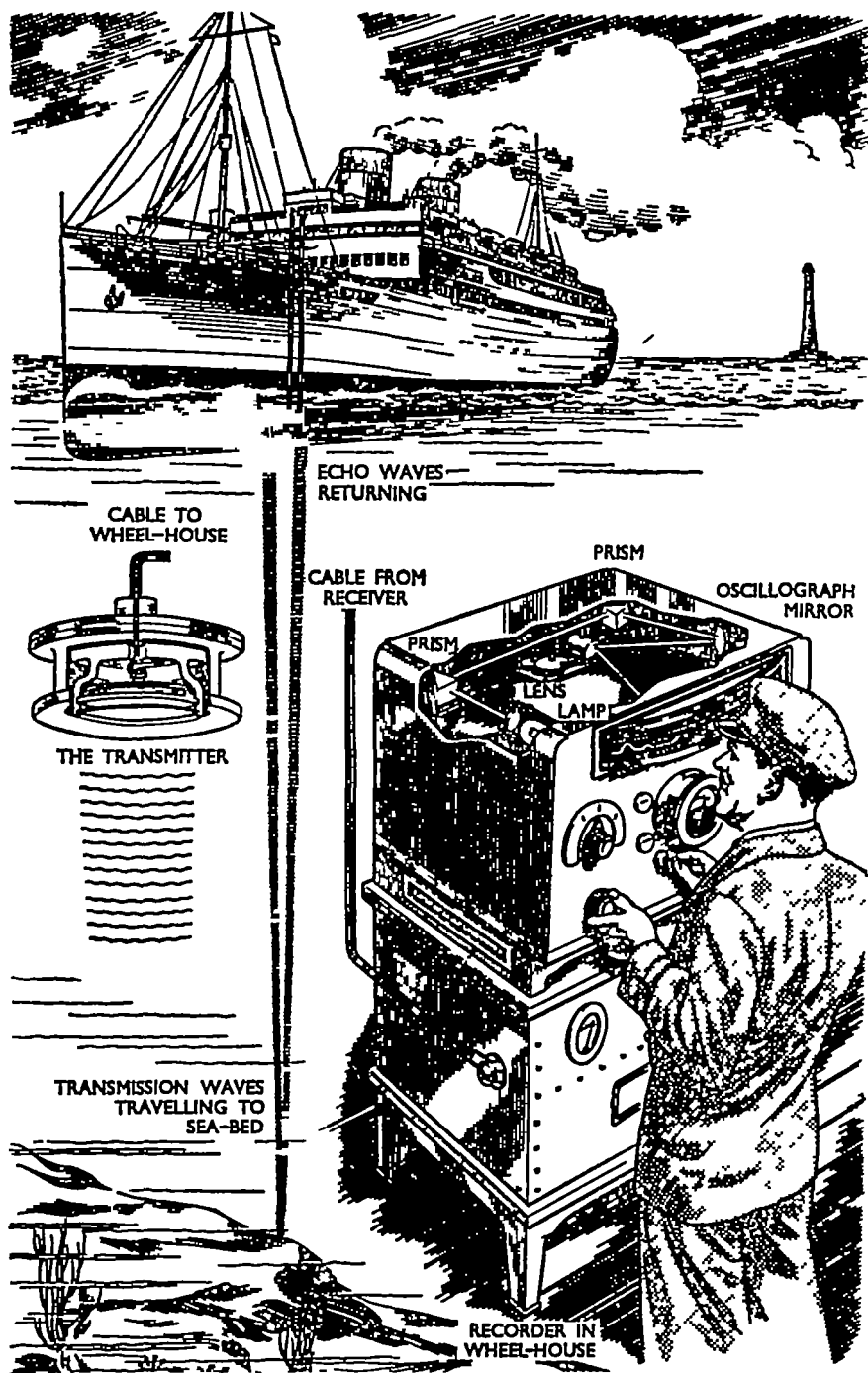
SOPHOCLES (495–406 B C), of Athens, was the rival of **EURIPIDES** in the production of Greek tragedies among which are his *Antigone*, *Electra*, *Oedipus Tyrannus*, characterized by high passion and morality

SOUND is a sensation in the **EAR** caused by vibrations in solids, liquids, or gases, of a **FREQUENCY** of between 20 and 20,000 **OSCILLATIONS** per second These vibrations or waves pass through the air at 700 miles per hour and through water at about 3,000 miles per hour

In geography, a sound or strait is a narrow passage of sea water between two pieces of land, such as an island and the mainland

SOUNDING is the method of finding the depth of the sea At one time it was done by means of a heavy sinker at the end of a long steel wire

Nowadays a sound impulse is sent from an echo-sounding machine on the ship to the bottom of the sea, where it is reflected and picked up again by a microphone



When sounding, i.e. measuring the depth of the sea, the echo-sounder sends a sound impulse to the sea-bed and notes how long the echo takes to come back

in the ship's bottom The depth is then automatically calculated and recorded from the time which has elapsed between the sending of the impulse and the receipt of the echo There are several forms of echo-sounding machine which work in this way the illustration on page 539 shows one of them

SOUTH AFRICA is that part of the continent south of the middle course of the Zambesi River, although the title is used generally for the **UNION OF SOUTH AFRICA**

SOUTH AMERICA is a continent extending from the northern tropics to the Antarctic regions. Almost two-thirds of the total area is within the **TROPICS**, but some of the Andes ranges are above the snow line, and in the extreme south glaciers are common The Andes contain many volcanoes, some active Between them and the eastern highlands are alluvial plains around the Rivers Orinoco, Amazon, and Plate and their tributaries The Amazon basin is a region of dense equatorial forest, to the north and south of it are wide plains, and farther south the temperate grasslands of the Plate estuary There are hot deserts in northern Chile and Peru, and cold ones in Patagonia in the southern Argentine

Most of the people live in the coastal lowlands and more temperate Andean plateaus, and include people of European, Negro and American-Indian origin, most of them mixed Indians live in the savannah and the equatorial forest Over large areas communications are poor The political divisions include the republics of **ARGENTINA**, **BRAZIL**, **CHILE**, **PARAGUAY**, **URUGUAY**, **PERU**, **BOLIVIA**, **ECUADOR**, **COLOMBIA** and **VENEZUELA**, and the colonies of British, Dutch and French **GUIANA** Most of the early settlement was by Spaniards and Portuguese, and

their languages are still the official ones, Portuguese in Brazil and Spanish elsewhere

Of the original inhabitants, the **INCAS** had reached a high standard of civilization, building great cities and roads and introducing irrigation, but their descendants today are mostly primitive in their ways of life

SOUTHERN RHODESIA is a self-governing African colony of the British Commonwealth Although the country lies partly within the tropics, the climate is fairly temperate on account of its high position, and European settlement is being encouraged Mineral wealth includes gold, asbestos, chrome ore and coal, and maize, tobacco and oranges are exported Salisbury and Bulawayo are the chief towns See map of the **UNION OF SOUTH AFRICA**, which it adjoins

SOUTH-WEST AFRICA is a former German territory, administered now as part of the Union of South Africa Some of the small number of European settlers are of German descent Most of the coastlands are desert, except in the north, farther inland are mountains and the western edge of the Kalahari Desert The capital is Windhoek Its exports include diamonds See map of the **UNION OF SOUTH AFRICA**

SOVIET The basis of the Russian method of government is the Soviet, a council elected by the workers Each village, town, and factory has its Soviet, and above these are district Soviets and Regional Congresses From these, representatives are sent to the All-Union Congress of Soviets which meets once a year Its chief duty is to elect the Central Executive Committee, which in turn elects a Praesidium, as it is called From the Praesidium is chosen the Council of

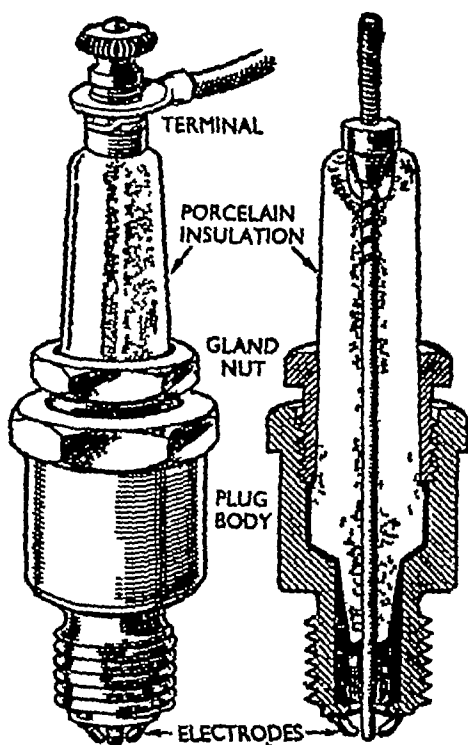


Map of South America, showing the countries, chief towns, mountains, rivers and railways, and the oceans which wash its shores

Ministers, the heads of the various government departments, or Cabinet as it is called in Britain. STALIN, chairman of the Council, acts as Premier. See also UNION OF SOVIET SOCIALIST REPUBLICS

SPAIN is a country occupying most of the Iberian Peninsula. The Mediterranean coast lands are cultivated by irrigation, and oranges and almonds are produced. The hill slopes rising to the central plateau of the Meseta are terraced for vineyards and olive groves. Barcelona, on the east coast is the chief port; textiles and machinery are manufactured by means of HYDRO-ELECTRICITY from the Pyrenees. The region round Barcelona in Catalonia differs considerably from the rest of Spain in language and customs. Andalusia, in the south-west, is famed for Seville oranges, sherry and olives, the people have a strain of Moorish blood dating from the Moorish occupation. The northern BASQUE coast lands have numerous fishing ports, coal is mined near Oviedo and iron-ore near Bilbao. Madrid, the capital, lies in the centre of the Meseta where wheat and wool are the main products. Much of Spain has poor soil, and her mineral deposits of copper, lead and silver have not yet been fully exploited. In the Balearic Islands in the Mediterranean, fruit-growing and fishing are the chief occupations. Majorca and Minorca are well-known tourist centres. The Canary Islands, off north-west Africa, export early vegetables and bananas. See the map of the **IBERIAN PENINSULA**.

History In the Middle Ages the MOORS overran Spain and were there until the 15th century. After the REFORMATION Spain was the leader of Catholic Europe, she organized a great empire and fought England in 1588. See **ELIZABETH**



Spark plug and what is inside

Gradually the power of Spain ebbed away and by the 19th century she had lost all her European possessions and South American colonies.

In 1931, King Alfonso was driven from Spain by an anti-monarchist revolution, and a Republic was proclaimed. In 1936 after the election of a left-wing government, a revolt broke out in many military garrisons in Spanish Morocco and spread rapidly to Spain. The leader was General Francisco Franco, formerly governor of the Canary Islands. Civil war raged for three years, and in 1939, the Government surrendered to the Nationalists (as General Franco's supporters were then named). The victorious rebels thereupon set up a Fascist form of government.

During the two World Wars Spain remained neutral, though an open friend of the Fascist Powers, Germany and Italy, in the Second World War.

SPARK, ELECTRIC, the passage of electricity through a bad conductor, such as air, accompanied by light and sound See also **LIGHTNING**

SPARKING COIL See **INDUCTION COIL**

SPARKING PLUG, a device to provide a hot spark in an internal combustion **ENGINE** to fire the explosive gas mixture

It consists of a conducting core of metal with a terminal at the outer end, a surrounding sleeve of insulating material which is not affected by heat, and an outer shell of metal which screws into the cylinder head When a high voltage is applied to the outer terminal, a spark jumps across between the inner end of the core and a raised point on the outer sleeve See **INDUCTION COIL**

SPARROW The cock house-sparrows are distinguished from the hens by their darker crowns and black breasts House-sparrows are chiefly town-living, grain-eating birds, which may flock to harvest fields in summer Hedge-sparrows are unrelated insect-eating birds with slender bills

SPECIFIC GRAVITY, or relative density, is the weight of any volume of a substance divided by the weight of an equal volume of water

The weight of a gas is compared with the weight of an equal volume of air at the same pressure and temperature

SPECTROMETER, an instrument in which the **SPECTRUM** of a substance is examined and the light of different colours or their wavelengths measured

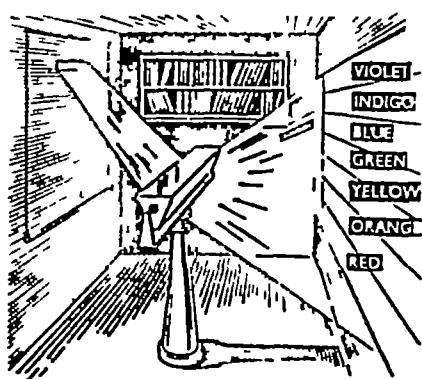
It consists of a narrow slit through which light from the substance is passed, a prism to split up that light into its various colours, a telescope to view the light emerging from the prism, and a scale which allows the deviation of

any particular emerging colour to be measured

SPECTROSCOPE, an instrument for examining spectra from substances

See **SPECTRUM**

SPECTRUM. When white light (which is made up of all the colours) is bent by refraction through a prism the light which emerges gives



Spectrum of white light

on a white screen a coloured patch in which the most bent end of the beam is violet and the least bent end is red Between these two colours is a continuous gradation of the colours of the **RAINBOW**

A film of oil also produces these colours by splitting up white light into its components

Different substances when heated strongly and turned to gases give spectra, in which many of the colours are missing and the rest are represented by light of very pure colour. These spectra can be used to identify substances present in very minute quantities See also **SPECTROMETER** and **SPECTROSCOPE**

SPEEDOMETER, an instrument for showing how fast a vehicle is moving or a shaft rotating One type is similar to a **GOVERNOR** the faster a wheel or shaft turns, the more a weight flies out and compresses a spring moving a pointer on a dial

Another type contains a rotating magnet which tends to turn a nearby disk to which is attached a pointer, showing how fast the magnet is turning

SPENSER, Edmund (about 1552–1599), was born in London. He was given a position in the service of the Earl of Leicester, at that time high in favour with Queen Elizabeth. He made the acquaintance of Sir Philip SIDNEY, Leicester's nephew, whose sympathy stimulated his own poetic gifts. To Sidney was dedicated



Spenser, Elizabethan poet

Spenser's first important work, *The Shepheardes Calender*, a collection of twelve PASTORALS. In these poems Spenser revived many old English words which had fallen out of use, and employed dialect phrases—far from courtly, it was thought—drawn from the speech of the North and Midlands.

In 1580 Spenser was appointed secretary to Lord Grey, Lord Deputy in Ireland, where in 1589 Sir Walter Raleigh came to visit him. Raleigh brought Spenser back

with him to London at the end of 1589, the poet apparently hoping for an appointment at Elizabeth's court, his hopes were unfulfilled.

In 1591 he returned to what he regarded as exile in Ireland. In 1594 he married Elizabeth Boyle, in whose honour he wrote his sonnets, the *Amoretti*, and a wedding-hymn, the *Epithalamion*. After another visit to London, during which further books of *The Faerie Queene* were published, he was appointed Sheriff of Cork in 1598. During the rising led by the Earl of Tyrone his home was destroyed, and with difficulty he escaped alive. He returned to England in 1598, to die soon after. He was buried in Westminster Abbey.

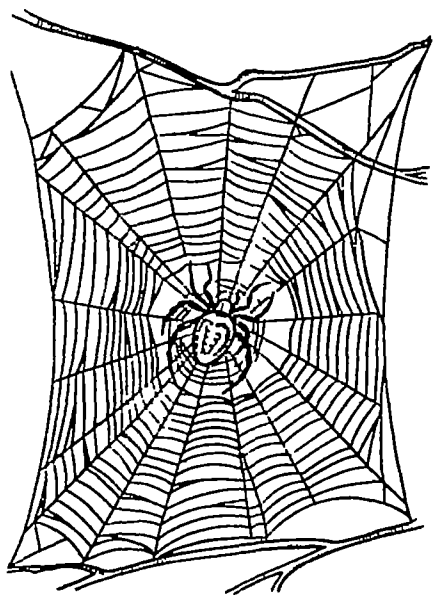
Spenser is unrivalled as a painter of word pictures, even in his tales of action he lingers over every description of scenes and persons. *The Faerie Queene* retells the stories of King Arthur and his Knights, but Spenser introduces new features of his own: the characters are the embodiment of virtues and vices and at the same time they are portraits of some of his contemporaries, Queen Elizabeth being glorified as the Faerie Queene and the Earl of Leicester as King Arthur. Such literary compliments were in keeping with the spirit of Elizabeth's court.

SPHERE. See MENSURATION

SPHINX, a famous monster of Greek legend, part woman, part beast, which dwelt near Thebes. Here it devoured those who could not answer its riddles, until Oedipus, solving one of its questions, ended its life. The legend of the Sphinx probably came from Egypt, where the famous statue stands near the Pyramids. It was among the SEVEN WONDERS OF THE ANCIENT WORLD.

SPIDER, an ARTHROPOD, differing from insects in having four pairs

of legs and a body divided into two regions Spiders have powerful, often poisonous, jaws Spinnerets at the body end give out silk, which is spun into elaborate webs, used to



Spider and its delicate web

line burrows, to bind victims, or, by water spiders, to trap air in a "diving-bell" Mites, harvest-men and ticks are related Many of these are PARASITES, and may carry serious diseases

SPIDER STITCH See **KNITTING**
SPINET, an early **KEYBOARD** **STRINGED INSTRUMENT**

SPITSBERGEN, group of islands belonging to Norway in the Arctic Ocean See map of **GREENLAND**, near which they lie

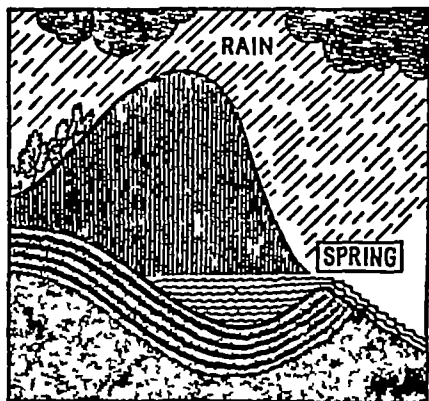
SPONDEE See **PROSODY**

SPONGE, a very lowly form of animal, consisting of numbers of cells with a skeletal framework made of horny, limy or silky material Bath sponges are fished for and cultivated in the West Indies and China, and the skeletons cleaned and dried The growth of a fresh-

water sponge sometimes blocks water supply pipes

SPONTANEOUS COMBUSTION Some substances will burst suddenly into flame without being ignited this is known as spontaneous combustion For instance, phosphorus, especially in thin layers, oxidizes so rapidly that it becomes hot and burns fiercely, and damp hay, if stacked too soon, ferments and becomes so hot inside that the centre will char, and the whole stack may then catch fire

SPRINGS of water appear along the junction of porous and impervious layers of rock Where porous rock, such as chalk or sandstone, lies over non-porous or impervious rock, such as clay, water soaks through the porous rock until it reaches the impervious rock and there collects Springs drain these underground supplies naturally, but wells are often constructed in



Water collects on impervious rock and overflows to form a spring

addition Hot springs occur, in volcanic areas particularly, where water after sinking to a great depth is forced to the surface again along a crack See **ARTESIAN WELL**, **GEYSERS**

SQUARE See **MENSURATION**.

SQUID. See **MOLLUSC**

SQUIRREL. The red squirrel is russet-coloured with white chest. It spreads its plumed tail to help it



Squirrel

parachute down as it leaps from a higher to a lower branch. Its home, the drey, is a rough nest of sticks high up a tree, or a hollow tree may be used.

The squirrel

HIBERNATES, and buries stores of nuts for winter days. Grey squirrels were introduced into Britain from America, and have spread rapidly. They are more rat-like than the red squirrel, with poorer tails. They learn to take nuts from the hand.

STAINLESS STEEL is a type of steel containing 10-20 per cent chromium, and resistant to corrosion and rusting.

STALACTITE, a cone from the roof of a cave, produced by limy matter trickling through the ground above; the moisture evaporates and leaves a deposit which continually grows towards the ground.

A stalagmite is formed by the limy matter falling to the floor of the cave and building a cone on

the ground. Sometimes a stalactite and a stalagmite meet to form a continuous pillar.

STALAGMITE. See **STALACTITE**.

STALIN, meaning "the Man of Steel," was the name given by **LENIN** to Josef Djugashvili, because of his coolness and hardness at times of crisis. He was born in 1879, son of a peasant who became a shoe-manufacturer. His mother sent him to a religious college, but he was arrested at Baku when he was twenty-three for revolutionary activities with the Social Democrats, imprisoned for a year, and then sent to Siberia. He escaped and returned to the Caucasus, where he organized revolutionary journals. He met Lenin at a Bolshevik conference in Finland in 1905, and he organized the Bolshevik Party in the Duma (Parliament) called by the Tsar. He was several times arrested, but usually managed to escape.

He became secretary of the Bolshevik Party and played an important part in the great Revolution of 1917, which laid the foundations of modern Russia—the **UNION OF SOVIET SOCIALIST REPUBLICS (U.S.S.R.)**, the largest country in the world, stretching from Central Europe across Asia to the Pacific. In 1928 Stalin began to build the new Russia by his great Five Year Plans—in industry, agriculture and education, plans interrupted by the Second World War and resumed after the defeat of the Germans in 1945.

STAMP-COLLECTING is a fascinating hobby and of educational value, for through it much is learned concerning such subjects as history and geography. A serious collector is called a philatelist.

To start, all you need do is to obtain some stamps, a stamp album in which to insert them, and a packet of stamp mounts which



Stalactites and stalagmites



Joseph Stalin

serve to fix the stamps in the album in such a way that both sides of the stamp can be examined or the stamp removed from the album without damage

You can begin a collection with stamps which have been given to you, and add to it by exchanging your duplicates with those of other collectors. In some schools stamp clubs have been formed and the members meet periodically for discussions and the exchange of stamps. Then there are stamp dealers' shops where you can buy any particular stamps you want.

The two chief kinds of paper in stamp production are (1) *voove*, when the texture is even and does not show any particular pattern if held up to the light, and (2) *laid*, when you can see parallel lines in the texture, similar to cream laid writing paper. Paper also can be white or coloured and many stamps have watermarks.

Stamps are printed mainly by

line-engraving, similar to a green £1 note, by *letterpress*, as was this book, by *lithography*, and by *photogravure*, used for the current low value stamps of Great Britain. See PRINTING.

The margins between each stamp are either *perforated* (have holes punched right out), *rouletted* (have a series of cuts which do not remove any paper), or are *imperforate* (have neither holes nor cuts, so that the stamps have to be cut apart with scissors).

Perforations and roulettes are measured by the number occurring in the space of two centimetres. Measurement is made with a perforation gauge, a card bearing a number of rows of equally spaced dots, one row above the other, and each following row containing fewer dots than that above it. You measure a perforation by putting a stamp on the card and moving the stamp up or down until a row is found in which all the dots coincide exactly with the perforation holes along the edge of the stamp. The number of dots in that row is the stamp's perforation.

Stamps which are rare command very high prices, sometimes running into thousands of pounds. Every stamp collector should make himself familiar with the appearance of rare stamps, photographs of which are to be found in most albums.

Postage stamps display an extremely wide variety of shape, size, subject and colour and great care is given to their design.

Some stamps have heads or faces of famous people depicted on them, others aeroplanes, flags, animals, great events, and so on.

STANDARD TIME is based on Greenwich Mean Time (G.M.T.). The earth rotates once through 360 deg., in twenty-four hours, that

is, 15 deg per hour Midday or noon occurs when the sun reaches its highest point in the sky and as the earth rotates from west to east, places east of Greenwich have noon before Greenwich When it is noon at Greenwich (longitude 0 deg) places in longitude 90 deg east (e g north-west India) have reached 6 p m G M T, and places in longitude 90 deg west (e g parts of Mexico) are at 6 a m G M T

When travelling eastwards from Greenwich clocks are advanced one hour after every 15 deg until in longitude 180 deg east they are twelve hours fast on G M T. When travelling westwards clocks are put back until in longitude 180 deg west they are twelve hours slow on G M T Longitude 180 deg east and 180 deg west are the same meridian, and the International Date Line follows this meridian, except where it diverges to avoid land, therefore ships travelling eastward across the line reckon their time as twenty-four hours or one day earlier, and ships travelling westward across the line reckon their times as twenty-four hours later See map of the WORLD

STANZA. See **PROSODY**

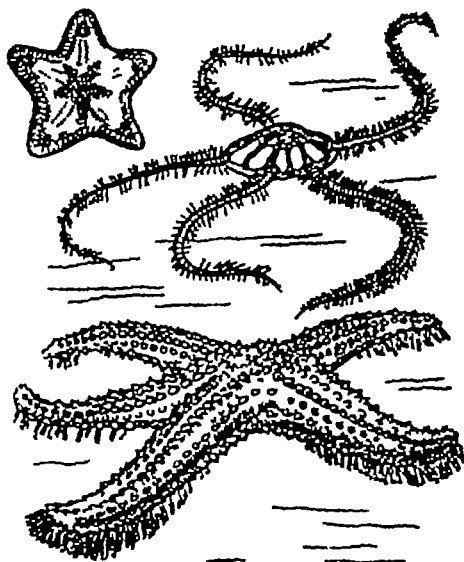
STAR, any heavenly body, but generally applied to those outside our own small SOLAR SYSTEM Stars keep a comparatively fixed position and so form patterns in the sky

STARCH is a CARBOHYDRATE built up and stored by plants (The potato is a mass of starch granules) It is converted into sugar by boiling with weak acid, but inside the plant cells this conversion is done by substances called **ENZYMES**

STAR CHAMBER, a Court of Justice set up by HENRY VII to try nobles and others who were too powerful to be tried by the ordinary courts, it also dealt with juries who gave unsatisfactory verdicts The

Court took its name from the room at Westminster in which it was held—"the chamber of the stars"—so-called from the starry decoration on the ceiling It was abolished by the Long Parliament in 1641

STARFISH belong to a group of sea animals which includes sea-urchins Most have radiating arms,



Three sorts of starfish

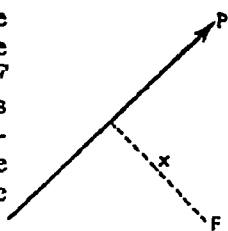
with a central mouth below They move by numerous little tube-feet, and feed on shellfish New arms are grown should one or more be lost

STARLING, a BIRD, roosting in large, noisy flocks in autumn Its plumage shows a metallic sheen It is an excellent mimic, often copying other birds' songs

STATICS. Nothing in the world is truly still, everything is continually acted on by gravity and other forces, but if two or more forces are in equilibrium (balance one another) their combined effect on a body is nil, and the body is said to be still or at rest The study of forces in equilibrium is called statics

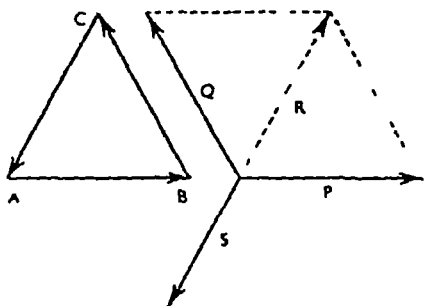
The *moment* of a force about a point is the product of the force and the perpendicular distance from the point to the line of action of the

force The moment of the force P about F is Px , where x is the perpendicular distance from F to the line P



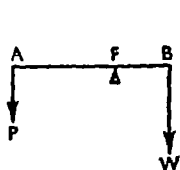
A *lever* is a rigid rod resting on a fulcrum at some point (1) Fulcrum between pressure (P) and weight lifted (W), $P \times AF = W \times BF$ (2) Fulcrum (F) at end, upward pressure (P) at other end, weight lifted (W) between pressure and fulcrum, $P \times AF = W \times BF$, i.e. moment of pressure about F = moment of weight about F (3) Pressure applied between fulcrum and weight, $P \times AF = W \times BF$

Triangle of Forces Three forces in equilibrium may be represented by the sides of a triangle taken in order—in magnitude and direction, but not in the point at which they are applied P, Q and S are in equilibrium ABC is the triangle

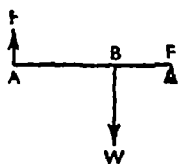
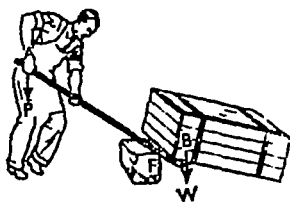


of forces AB parallel to and equal to P , BC parallel to and equal to Q , CA parallel to and equal to S . S is equal to and opposite to the resultant R of P and Q the resultant of two forces acting at a point is found by completing the parallelogram—the diagonal represents the resultant, that single force equal in effect to the original two forces

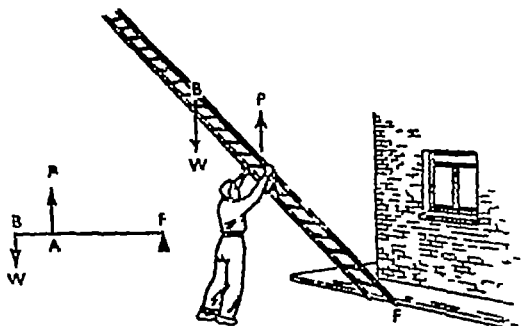
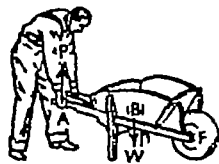
STATISTICS are sets of figures dealing with a particular subject which have been obtained for the purpose of examining that subject in its broad aspects. Statistics are much used in estimating matters such as population, crime, disease, accidents, wealth, food-growing, and so on. The figures obtained are shown in the form of tables or as a **GRAPH**, and from them **AVERAGES** can be worked out, variations from year to year noted, and future trends foreseen



1 *Lever of the first order*



2 *Lever of the second order*



3 *Lever of the third order*

STATUTE of WESTMINSTER.

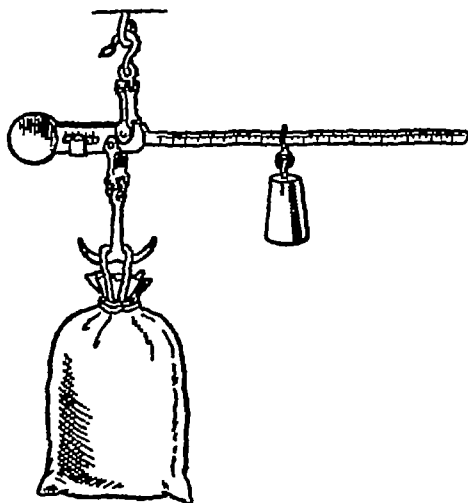
See BRITISH COMMONWEALTH OF NATIONS

STEAM is correctly the invisible gaseous state of water. The word, however, is usually used for the visible cloud of water droplets which have condensed in the cool air

STEAM ENGINE See **ENGINE**

STEEL is an **ALLOY** of iron with carbon and other substances. Other elements are often added for special purposes

STEELYARD, an instrument for weighing heavy loads. It consists of a pivoted steel beam with a hook on



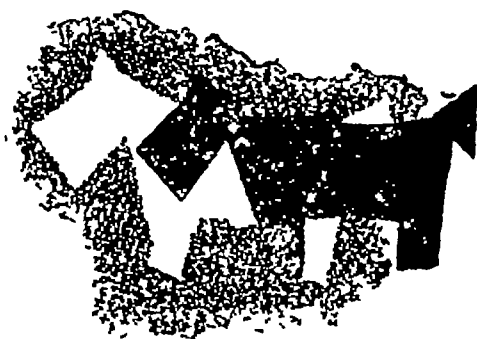
Steelyard for weighing

the shorter end to carry the load and a balance weight which is slid along the graduated beam on the other side until the beam rides absolutely level

STEM STITCH is a neat and simple stitch used in embroidery generally as an outline stitch. The illustration shows the method of working. You will notice that the thread is always kept to the right of the needle



Stem stitch



Negative and positive stencils

STENCILLING, a simple art craft, popular in schools. It consists of cutting out a shape or design or lettering previously drawn on stiff paper and of printing the design thus made on to paper or cloth or other material with a stencil brush.

A simplified shape is first chosen and drawn on paper. (It may then be transferred to oiled stencil paper.) It is then cut out with a sharp-pointed knife against a glass or zinc sheet. The paper from which the shape has been cut is next laid flat on the surface to be decorated and a stencil brush lightly loaded with colour is applied all over the cut-out space, thus transferring the design to the surface below. Colours used may be water paint, oil paint, tempera or even dye, but in no case should the colour be too moist.

What has been described is a "positive" stencil. A "negative" or "outside" stencil print may be got by using the shape cut out, and stencilling over its edges.

Stencils are used mainly to repeat units of a pattern. But they can be used for individual designs, for borders, for notices incorporating numerals and letters, and for duplicating any work for which you have designed the stencil.

STEPHEN (reigned 1135-1154), became King of England on the death of his uncle, Henry I. The country suffered from civil war

between Stephen and his cousin, the Empress Matilda, Henry's daughter, who claimed the crown. The king could not keep his barons in order, they built castles without permission and made them "dens of wicked robbers."

Stephen was succeeded by Matilda's son, Henry Plantagenet (Henry II).

STEPHEN, St., one of the seven deacons chosen by the APOSTLES to help them. He was stoned by the Jews because he was a follower of Christ, and was the first Christian martyr. His feast is on 26th December.

STEPHENSON, George (1781-1848), the great engineer, was not sent to school but at an early age went to work on a neighbouring farm. At the age of fourteen he was given the job of helping his father, who was fireman of one of the engines at Dewley Colliery. Later he was given charge of the pumping engine, which gave him the opportunity of studying the construction and mechanism of the engine.

At eighteen years of age he attended evening classes and was taught reading, writing and arithmetic. After that he studied mechanics.

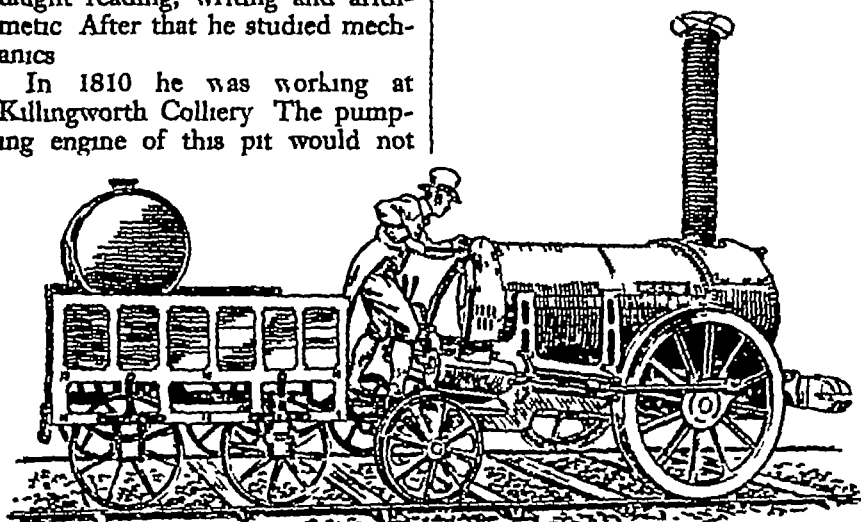
In 1810 he was working at Killingworth Colliery. The pumping engine of this pit would not



Stephenson, railway engineer

work, but he soon got it going again and in consequence, he was made engineer of the Killingworth pits.

Stephenson now began to give thought to the possibility of producing a locomotive engine, and, having seen one at work he constructed one for the Killingworth



With this locomotive, the "Rocket," Stephenson won a prize

Colliery which could pull a load of thirty tons at a speed of about four miles an hour

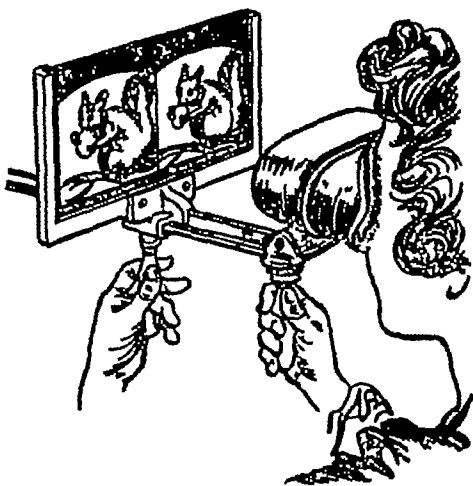
In 1821, a company was formed to construct a railway from Stockton to Darlington. For this venture Stephenson was appointed engineer and having laid down the railway track he had then to design a locomotive engine. So successful was he that his engine, *Locomotion*, was capable of drawing ninety tons of coal at twelve miles an hour. The railway was opened on 27th September, 1825, and the *Locomotion* drew a train which consisted of loaded wagons, a coach for the directors and their friends, and other passenger wagons. This was the first railway in the world to carry goods and passengers, and the success of the undertaking resulted ultimately in the spread of railway transit over the whole world.

When the Manchester to Liverpool Railway was nearing completion a prize of £500 was offered for the best locomotive which could be produced, and this was won by Stephenson with his locomotive, *The Rocket*. The last years of his life he devoted to horticulture and agriculture.

STEPPEs are broad, uncultivated, treeless plains, characteristic of the region in south Russia where Europe and Asia meet.

STEREOSCOPE. Our eyes, being some distance apart, get different pictures of the scene in front of us. This can be tested by looking out of a window and shutting first one eye and then the other.

If two photographs are taken by two cameras in the same position as our eyes, then they will be slightly different from each other. The stereoscope is a device by which the right eye sees the photograph from the right-hand camera, and the left eye sees that from the left-hand



Simple type of stereoscope

camera. The brain then constructs an image which has all the depth and solidity of the view photographed.

STEVENSON, Robert Louis (1850-1894), was born in Edinburgh. Because of poor health Stevenson travelled a great deal, his



R. L. Stevenson lived in Samoa

Inland Voyage and *Travels with a Donkey in the Cevennes* both describing tours in Europe. In 1888 he settled in Samoa, where he died.

Although a writer of adventure stories of which *Treasure Island* is the favourite, he was a literary artist with a fine sense of atmosphere and character, as may be well seen in *The Master of Ballantrae*, *Kidnapped* and *Catriona*. His settings are often the Scottish Highlands and the South Seas. He loved the *macabre*—the terrifying atmosphere in which the gruesome blends with the grotesque on the border of the supernatural. *Dr Jekyll and Mr Hyde*, *Markheim* and *Thtawn Janet* are examples.

STICKLEBACK, a fish with both freshwater and sea varieties. Some of the fin-rays at the front end of the back fin project as spines or stickles. The three-spined stickleback is common in ponds and rivers. In spring the male has a red breast and blue eyes. He makes a muff-shaped nest of waterweeds, and guards the eggs and later the small fry in a most warlike manner.

STILL LIFE Ordinary everyday things, like jars and fruits and loaves of bread, when depicted in art, are known as still life. A strange example is Picasso's "Fishes," in which a pattern is made of common objects—a newspaper, fishes, etc. More commonly the still-life subject is painted realistically by the artist.

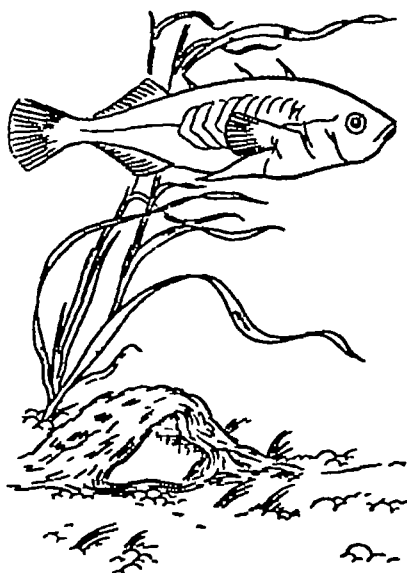
STINGS from bees, wasps and hornets vary in the severity of their effects on different people.



The stoat eats small animals

Bees' stings remain in the wound and must be removed. Ammonia, "blue-bag," and other ALKALINE substances help to ease the pain.

STITCHES in plain sewing are worked to secure all hems, seams, etc., and should be neat, small, and inconspicuous. See BACK STITCH, BLANKET STITCH, BUTTONHOLE STITCH, HEMMING, HERRINGBONE, OVERSEWING, RUNNING STITCH, SLIP STITCH and TACKING.



Stickleback guarding its nest

STOAT, a British FLESH-EATING MAMMAL, about fourteen inches long, brown above and yellowish-white below, with a black tail tip. The northern stoat's fur turns white in winter, and is called ermine. The tail tip remains black.

STOCK EXCHANGE, a market where stocks, SHARES, bonds and debentures are bought, sold, or exchanged. Anyone wishing to buy or sell stocks and shares deals with a stockbroker, the stockbroker deals with a jobber who actually does the buying and selling. Each jobber usually deals in one particular kind

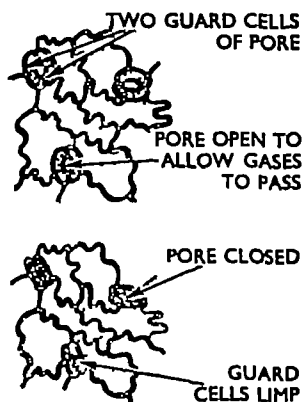
of share, such as shipping, oil, or diamonds

STOCKINGS, RENOVATIONS. For *hand-knitted* socks and stockings, when both heels and toes wear badly, it is best to unravel the worn part as far as the beginning of strong fabric, re-KNITTING from there Small holes can be DARNED, and thin places reinforced with single darning

For *silk* stockings, apply soap to a ladder, if a stocking is being worn, and this will stop it running To mend the ladder, use a fine CROCHET hook or a hook made for the purpose, and crochet the dropped loop upwards and secure it with a small stitch Another method is to turn the stocking to the wrong side, catch the loop securely with a BACK STITCH, if only one loop has run, the ladder can be OVERSEWN neatly on the wrong side If more than one loop has run, fold the stocking down the length of the ladder, and, beginning one thread beyond the ladder, sew with RUNNING STITCH carefully a little distance from the laddered part

STOCKING STITCH. See KNITTING

STOMATA are pores in the skin of a leaf or green stem, through which water vapour passes out and gases are exchanged They are



Stomata open and then closed

especially numerous in the undersides of leaves Each pore is flanked by two sausage-shaped guard cells, which open or close the minute pore according to whether they are full of sap and curved, or contain little sap and collapse against one another

See TRANSPIRATION

STONE AGE, the earliest stage of the story of man as far as it can be traced Men in those distant ages used tools and weapons made of stone, which they sharpened and shaped by chipping stone against stone, and later by grinding and polishing

There were two Stone Ages In the *Old Stone Age*, men wandered about, following animals which they killed for food and for the skins with which to make clothing They also gathered nuts and other food, caught fish, but grew no crops Their tools and weapons of flint are rough and unpolished, and are found in caves and in old river beds They used caves as shelters, and drew wonderful pictures of animals on the cave walls They learned how to make fire The *New Stone Age* existed when men lived in hut villages, and in huts built on piles in lakes (as in Switzerland) Their tools and implements were finer, better made, polished and ground They pierced their axe-heads and hammer-heads and fitted them with handles They learned to till the land and grow crops of corn and flax They tamed animals for domestic purposes They made good pottery, and could spin wool and flax into yarn and weave coarse cloth From their boats they fished with nets and with hooks made of bone They buried their dead in big mounds of earth, called barrows, and in sepulchres built of stone—this is when Stonehenge was erected But they still knew nothing of

OLD STONE AGE



IN SEARCH
OF FOOD



SPEAR

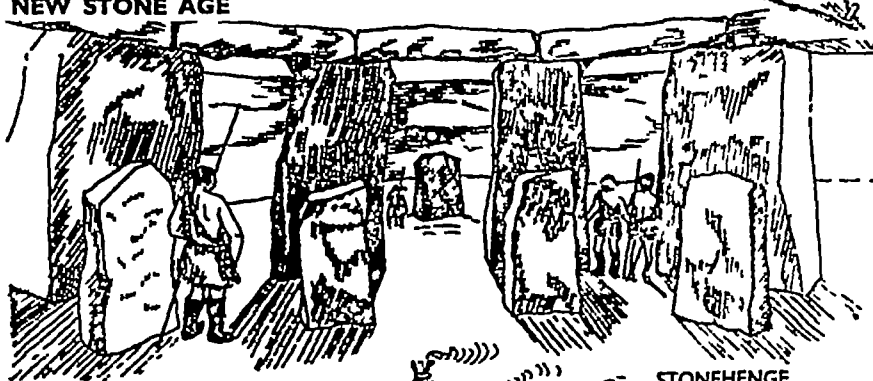


MAKING FIRE



CAVE
DWELLERS

NEW STONE AGE



STONEHENGE
SEPULCHRE



SICKLE

HUTS



CUTTING CORN

MAKING
POTTERY



Scenes of everyday life in the Old and New Stone Ages

metals, and their tools and weapons were of stone, bone, or horn

In Britain the Old Stone Age began perhaps about 50,000 years ago, and the New Stone Age about 12,000 years ago. About 4,000 years ago metal-workers (Celts) came to Britain, and, after a short Bronze Age, the Iron Age, in which we still live, began

STORK, a large black and white BIRD with long neck, long beak,



Stork with long legs for wading

and long legs for wading. It migrates from Africa (see MIGRATION), and often builds its nest on roof-tops

STRATOSPHERE, a layer of the earth's atmosphere which begins at about seven miles or 37,000 feet up. The air pressure here is very low and the resistance to motion is therefore small. Balloons and rockets with scientific instruments attached have been sent up into the stratosphere, and the Belgian Professor Piccard has

himself ascended over ten miles in a special balloon

STRAUSS is the surname of a remarkable family of Viennese musicians whose light music attained world-wide fame. The elder Johann Strauss (1804-1849) composed dance music and toured the world with his band. His sons Johann, Joseph and Eduard followed in his footsteps. Of these Johann was the most distinguished, and is known to us as the composer of the "Blue Danube" and many other waltzes, and of the opera *Die Fledermaus*

STRAUSS, Richard (born 1864), is no relation of the other Strauss family. He is a German composer, best known by his symphonic poems and by his operas

STREAMLINING. If a rough block of wood is pushed through water or at a high speed through air, then a lot of energy is wasted because neither the water nor the air flows smoothly over the surface of the block. If, however, the block is made fish-shaped the air or water slips smoothly over its surface and little opposition is encountered. The streamline shape is used for aircraft fuselages and wings, and many other purposes

STRINGS, the stringed instruments of the ORCHESTRA. They are the VIOLIN, VIOLA, VIOLONCELLO and DOUBLE BASS

STUDY, HOW TO. The ability to study effectively is important when you are at school, but it is even more important in your working life. To study properly, you should have an intense desire to know something about the subject. Curiously enough, the more you know about a subject, the more it becomes your personal property, so to speak, and the more you take a pride in finding out even further facts. Make, therefore, the collect-

ing of facts about a topic a matter of personal pride, and discuss the points with friends who are interested in the same thing

Most information is picked up by reading, so good reading habits are valuable. Let the conditions in which you read be as favourable as possible. Have a good light, if possible, a quiet room, be comfortable. Then, having decided on a reasonable amount of work to be done, get on with it. If you find yourself mind-wandering, remind yourself of the importance of the work on hand as a means of creating good study habits, and bring your mind back again to its task. A little regular study every day is far better than a large amount once a week. And the sooner it becomes automatic, the better. If you are physically fit, there should be no effort entailed, so get plenty of exercise as part of your system of effective study.

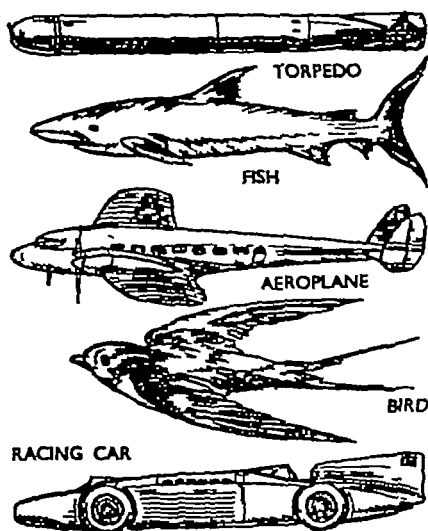
In studying, a good plan is to peruse a chapter quickly to see the main points. Then re-read the

chapter slowly and thoroughly, noting how each paragraph fits in with the scheme of the chapter. Always read with a pencil in your hand, and jot down notes as you go along, expressing each idea or fact as concisely as possible. This helps to keep you concentrated and leaves you with a neat record of what you have read. Making charts and tables out of the facts is good fun, and many people find things easier to remember when set out in this diagrammatic form. These notes, charts, or tables should be kept for reference and consulted from time to time.

Some people can remember the look of the written page in their note books, and the ability to do this can be developed at odd moments during the day by looking at one's surroundings, shutting the eyes, and seeing how much one can remember. With patience this eye-memory can be strengthened, and is very useful. Commit things to memory over a long period—last-minute cramming is useless.

Memorize facts and ideas, rather than the words expressing them. Repeat each fact or idea quietly to yourself with the definite intention of recalling it later. Then practise recalling when away from your notes.

In examinations, read through all the questions first. Select the one you feel you can answer best, and start on that. Note carefully what the question is asking you, and, before answering, decide what the examiner wants to find out from you. (Many people write easily, but take too little care to answer what they are asked.) Jot down on paper all the facts, names and terms you can remember about the topic. Next, re-arrange such facts, names and terms as you need in some sort of scheme or skeleton, grouping



Streamline shapes make for speed

similar facts together Finally expand each set of allied facts into a paragraph Remember to introduce your answer by some sentence designed to arouse the reader's interest in what follows, and conclude your answer with a general sentence rounding off what you have written

STYE, an inflammation of the eyelid, centring upon one eyelash Pain may be relieved by a poultice

STYLE, in literary composition, the way in which you write A good style is clear, forceful and usually simple It is direct, not roundabout It is the careful choice of words, the writer avoiding the use of too many adjectives, high-flown expressions, hackneyed phrases, exaggerative words like *very*, and weak words like *somewhat* and *rather* Say what you have to say clearly Then strike out every word that does not pull its weight "Good style is proper words in their proper places" See also **ESSAY WRITING**

STYX is in **CLASSICAL MYTHOLOGY** the principal river of **HADES** See also **CHARON**.

SUBJECT (in grammar) See **GRAMMAR**

SUBMARINE, a small warship, which can move under the water as well as on top It is fitted with tanks which admit water, causing the vessel to sink when this water is blown out, the vessel rises On the surface, the propellers driving the vessel forward are turned by Diesel engines, which also work generators to generate electricity this is stored in batteries and when the vessel is submerged these batteries work the generators which now become electric motors for turning the propellers A periscope, a long tube fitted with prisms, enables the crew, when submerged just below the surface of the water, to see above the surface

SUBTRACTION, taking one quantity or number away from another. Place the number to be subtracted under the number which is to be reduced Proceed as follows 7 from 2 is impossible, borrow 10 from the tens 4882 column, 7 from 12 = 5, 1437 write 5 Borrowing 10 from 80 makes the 8 into 7; 3

from 7 = 4, write 4 4 cannot be taken from 3, borrow 10, 4 from 13 = 9, write 9 Borrowing 10 hundreds from 4,000 makes the 4 into 3, 1 from 3 = 2, write 2

As a check $1437 + 2945 = 4382$

Money Subtract from the right-hand end $\frac{1}{2}d - 0 = \frac{1}{2}d$, 9d from 2d cannot be done, so 12d must be borrowed from the shillings, 9d from \pounds 243 leaves 5d, 8s from 15s leaves 7s, 171 from \pounds 3 leaves 2, 7 from 4 cannot be done, so 10 is borrowed from the next column, 7 from 14 leaves 7 1 from 1 leaves 0, so there are no hundreds

Algebra There is a useful rule for subtraction in algebra change the signs of the bottom line, and add in the usual way

$$\begin{array}{r} \text{From } 4x^3 - 3x^2 + x - 8 \\ \text{Take } 7x^2 - x^3 + 7x + 2 \\ \hline -3x^3 - 2x^2 - 6x - 10 \end{array}$$

$$\begin{array}{r} 4 - 7 = -3, \text{ write } -3x^4, \\ -3 + 1 = -2, \text{ write } -2x^3, \\ 1 - 7 = -6, \text{ write } -6x, -8 - 2 \\ = -10 \end{array}$$

SUDAN. See **ANGLO-EGYPTIAN SUDAN**.

SUEZ CANAL, runs through **EGYPT**, joining the Mediterranean to the Red Sea, and providing a short sea route from Europe to the East It was completed in 1869 by de Lesseps It is at sea level all the way through Port Said is at one

end and Suez at the other It is administered by a French company Britain owns nearly half its shares

SUGAR is an almost universal component of plant juices, it is a **CARBOHYDRATE** used as a source of food by the plant It is extracted for human consumption from the sugar cane, beet, and maple, in which it is present in large quantities The juice is concentrated by **DISTILLATION** to give sugar and treacle

SUITE in music means three or four pieces to be played in sequence In classical music of the 17th and 18th centuries a suite contained four dances (1) *allemande*—a dignified dance (4 beats to the bar) hailing originally from Germany, (2) a *courante*, a quick running dance (3 beats to the bar) hailing from France or Italy, (3) a *sarabande*, slow and stately (3 beats to the bar) from Spain, and (4) a *gigue* or *jig*, a lively dance in compound time from England Other dances, such as a minuet, were often inserted before the jig, and this arrangement is a link between a suite and a symphony. See **FORM IN MUSIC** Today any loosely connected set of pieces can be called a suite

SULPHUR is a solid yellow non-metallic **ELEMENT** which burns easily with a blue flame giving off sulphur dioxide, a choking, poisonous gas Sulphur is used in the manufacture of sulphuric acid, fireworks and drugs, and in the vulcanizing of **RUBBER**

SULPHURIC ACID, oil of vitriol, is a corrosive acid and one of the basic materials of the chemical industry It is the acid in lead accumulators, and a phial of it is to be found in most fire **EXTINGUISHERS**

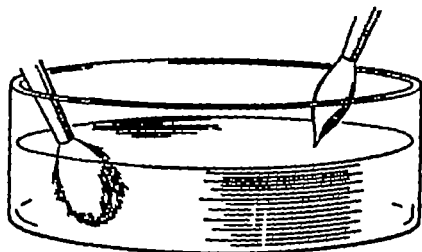
SUMATRA. See **EAST INDIES**

SUN, the body about which the **PLANETS** rotate It is about 93 million miles from the earth and about

864,000 miles in diameter Although its temperature is about 6,000 deg C, it is not burning in the ordinary sense that coal burns in air by combining with its oxygen The elements found by **SPECTRUM** analysis to exist in the sun are all found on the earth, and this suggests that the earth originally came from the sun but has cooled more quickly Most energy on the earth is derived from the light of the sun, either directly as in plant foods (see **PHOTOSYNTHESIS**), or indirectly as in rivers from rain from clouds formed by the sun, or coal from plants which grew in the sunlight of long ago

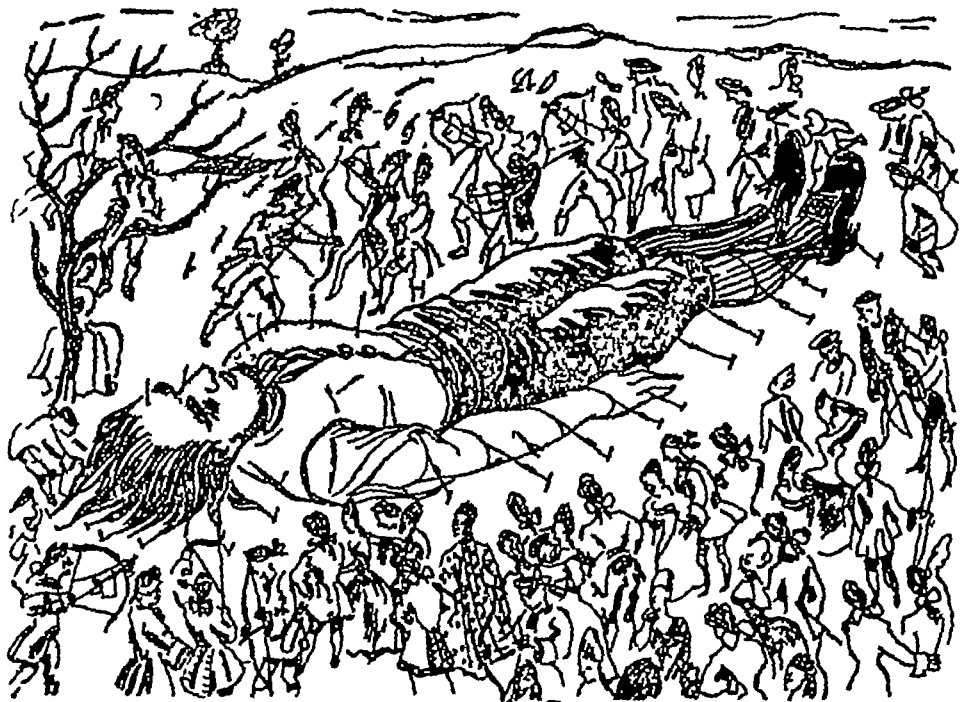
SUPERCHARGER, a pump which forces more explosive gas into the cylinders of an internal combustion **ENGINE** when, owing to low air pressure or high speed they are not getting completely filled A supercharger increases the height to which a plane may fly and the speed of a car

SURFACE TENSION. All liquids behave as if they had an elastic skin on top which is always trying to contract This contracting force is called surface tension and tends to resist any stretching of the surface See **CAPILLARY ACTION**



To illustrate surface tension

Dip a clean camel-hair paint brush into water The hairs of the brush will fluff out, but when the brush is lifted out of the water, the hairs tend to be pulled together into a sharp point by the water surface.



The hero of Swift's "Gulliver's Travels" visits Lilliput In

SURREALISM is a particular type or school of modern art. Surrealist painters paint what they see when their imagination is most free to roam, as when they dream. They show us their imaginings unhampered by reason or common sense. But they are at pains to work out these imaginings in designs and colour patterns interesting to the eye. So, too, surrealist poets attempt to write directly from the imagination without the censorship of intellect.

SWALLOW, a migrant BIRD (see MIGRATION) which hunts insects while flying, and builds mud nests lined with feathers on rafters in barns or similar places. Its plumage is blue-black with a reddish throat and forehead, its tail long and forked. There is a picture on page 76.

SWAZILAND is a small British PROTECTORATE at the southern tip of Mozambique. Cattle and sheep are reared, and maize and millet

grown. Some tobacco is exported. See the map of the UNION OF SOUTH AFRICA.

SWEDEN, adjacent to Norway, resembles Denmark in the extreme south. Farther north are lakes surrounded by agricultural land, giving way to forest and, in the extreme north, to TUNDRA. Timber is carried down the numerous short rivers, to sawmills at the mouths, and wood pulp and paper are the chief exports. Matches and textiles are also manufactured, and iron ore is mined. Most of the people live in the southern lowlands. The chief towns are Stockholm, the capital, Gothenburg, and Malmö on the south-west coast. Uppsala is a university centre. See map of SCANDINAVIA.

SWIFT, Jonathan (1667-1745), was educated at Trinity College, Dublin. In 1689 he came to England, but finding it hard to make his way, returned to Ireland and entered the Church in 1694. In



this land of tiny people, he has many strange adventures

1696 he was back in England, and met Esther Johnson, the "Stella" to whom he sent vivacious letters (*Journal to Stella*) and whom he is sometimes said to have married. His time was spent between England and Ireland, and in 1713 he was made Dean of St. Patrick's, Dublin.

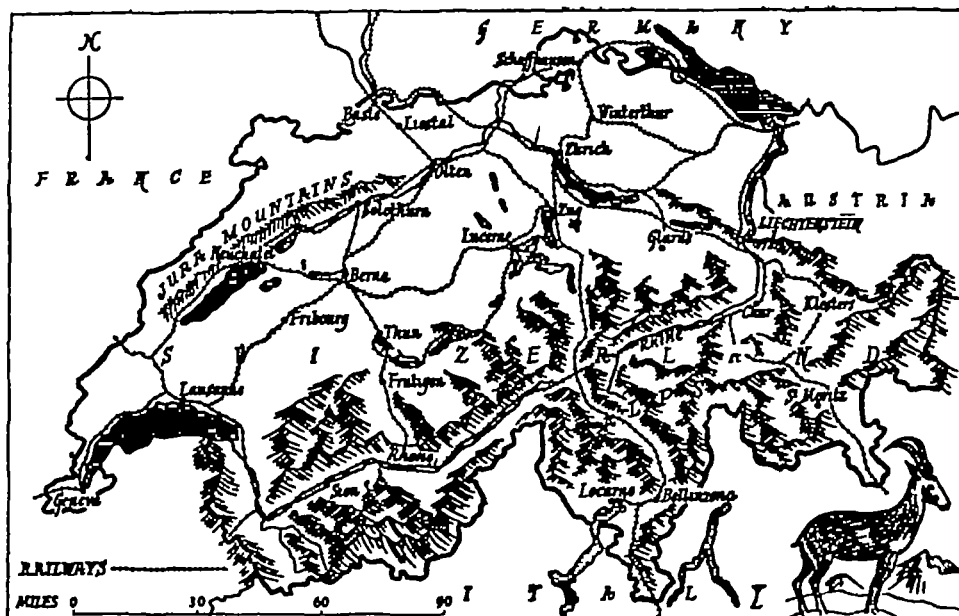
His satirical work is his best, in particular *Gulliver's Travels* in which Captain Lemuel Gulliver has remarkable experiences in four strange lands, among them Lilliput, the inhabitants of which are a few inches high, and Brobdingnag, the land of giants. Earlier satires on literary and religious subjects are *The Battle of the Books* and *A Tale of a Tub*.

SWIMMING The simplest way of propelling yourself through the water is by means of the breast-stroke. This is begun by extending the arms to the front as far as they will go, with the palms together and fingers and thumbs of each hand touching. (1) Sweep the arms

strongly, but not hurriedly, in a semicircle towards the body, at the same time drawing the legs up with knees turned outwards and heels close together. (2) As the arms are brought into the forward position to begin the next stroke, kick the legs outwards and backwards, keeping the ankles as loose as you can, continue these movements but always regularly and without flurry.

In the back-stroke, you lie upon the water looking up, legs together and straight, arms straight to the sides. (1) Carry the arms through the air until straight above the head and in line with the body, at the same time bringing the heels up to the body, feet and knees turned out, and kicking outwards strongly. (2) Sweep the straight arms through the water down to the sides again, at the same time bringing the feet together, thus getting back to the original position.

The easiest way to learn to dive is to stand on the edge of the



Switzerland, a country of high mountains well known to tourists

swimming bath, rise once or twice on the toes, extend the arms above the head, bend forwards arching the back, and spring from the toes, kicking the feet upwards

SWITZERLAND is a **FEDERAL** republic whose southern half lies amidst the Alps, the northern half consisting of a plateau and the Jura Mountains. Abundant water-power provides **HYDRO-ELECTRICITY**. Skilled workers manufacture high quality foods, cheese, tinned milk and chocolate are exported, and the magnificent scenery of the snow-capped Alps attracts many tourists and winter-sports enthusiasts. Here the nimble chamois, a goat-like animal, is to be seen. The capital, Berne, lies in the midst of the plateau to the north-east. Zurich produces textiles and embroidery, to the west Neuchâtel has a noted clock-making industry. In the south-west, Geneva also is famous for clock-making, and is the seat of the International Red Cross. German, French, Italian and Romansch are all official languages.

SYMPHONY. See **FORM IN MUSIC**

SYNAGOGUE, a meeting-house in which Jews worship God, study the Law, and perform other religious duties. The first synagogues were probably built during the **EXILE**, when the Jews could not go up to the temple at Jerusalem to worship. Jesus often taught in synagogues.

SYNTAX is the branch of **GRAMMAR** which deals with sentences and their construction.

Every sentence is a group of words which makes complete sense. This requires that each should have at least one subject and predicate.

Sentences are of various types.

(1) The Single Simple Sentence makes a single statement. *I am tired.*

(2) The Double Simple Sentence is made up of two single simple sentences usually joined by the conjunction *and* or *but*. *I am tired and I am going to bed.*

(3) The Multiple Simple Sentence is made up of three or more single simple sentences. *I am tired and I am going to bed but you must wake me up in an hour.*

(4) The Complex Sentence is made up of one main clause and one or more subordinate clauses (see below) *When the rain has stopped, I am going to visit Ted who is ill*

(5) Now imagine a sentence in which a statement such as we have in examples (1), (2) or (3) is linked on to such a statement as in example (4) *I am tired, but when the rain has stopped I am going to visit Ted (who is ill)* Here we have two main clauses and one (or more) subordinate clauses. It is called the Double Complex Sentence

(6) If you add more main clauses, you get the Multiple Complex Sentence *I am tired and I am going to bed, but, when the rain has stopped, I am going to visit Ted who is ill*

Clauses are parts of sentences

A main clause, if removed from the sentence will itself become a Single Simple Sentence *I am tired I am going to bed You must wake me up in an hour I am going to visit Ted* Each has at least a subject and a predicate

A subordinate clause, if removed from its sentence, makes sense so far as it goes, but does not make complete sense *when the rain has stopped* (doing the work of an adverb), *who is ill* (doing the work of an adjective) "He knew *what I meant*" (doing the work of a noun because equal to *my meaning*)

A phrase is a group of words without a finite verb *in an hour, going to the fair, along the seashore*

The relationship to each other of the individual words of the sentence can be broadly grouped under (1) agreement of connected words, (2) government of one word by another

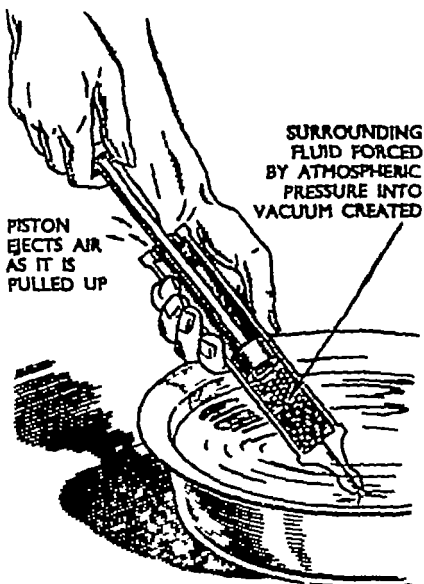
SYRIA and LEBANON are two adjacent Near East republics

Lebanon is a strip of high land lying along the east Mediterranean

coast, and Syria is mostly an inland plateau with a lowland area around the Euphrates. Oranges, olives and cereals are grown in Lebanon, and cereals and cotton in Syria, where some sheep and cattle are also reared. The capitals are Beirut (Lebanon), Damascus (Syria), and the chief towns are the ports of Beirut, Tripoli and Sidon, and the inland town of Aleppo in Syria. See the map of the NEAR EAST

SYRINGE, a small pump without valves, consisting of a glass or metal tube fitted with an airtight piston rod. As the rod is withdrawn air is ejected at the top of the tube and below the piston a vacuum is formed in the lower part of the tube, into this the surrounding liquid is forced by atmospheric pressure. When the rod is pushed in, the liquid in the tube is forced out again.

A hypodermic syringe is for injecting measured quantities of liquid drugs into the body. It has a hollow needle with a sharp point.



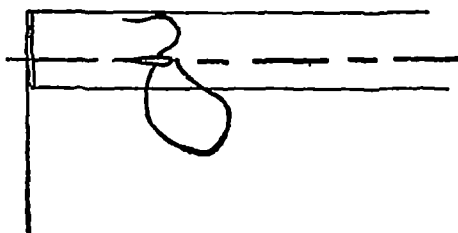
Pulling the piston fills the syringe



TABERNACLE, the tent which the children of Israel used in the wilderness as the holy place where God dwelt The name is sometimes given to dissenters' places of worship It is also given to the small cupboard in Roman Catholic churches in which the Blessed Sacrament is kept.

TABLE TENNIS is an indoor game between two or four players, played with a small celluloid ball and wooden bats (perhaps covered with cork or rubber) on a table 9 feet long by 5 feet wide and 2 feet 6 inches high, with a white strip $\frac{3}{4}$ inch wide round the edge It is divided across the middle by a net $6\frac{3}{4}$ inches high The players strike the ball alternately, and it must bounce once on the receiver's side of the net before being struck by him If a player puts it into the net or off the table or fails to hit it his opponent gains a point The first to reach 21 points is the winner, unless both reach 20 points when one player must get two clear points ahead to win The service is changed every 5 points, when serving, the server must see that the ball bounces first on his side of the net, otherwise he loses the point, should the ball after bouncing hit the top of the net then fall into the receiver's court, the stroke does not count and the server must serve again, but three consecutive net balls lose the point When four players are playing, the ball is struck by alternate opponents, no player may have two consecutive hits

TACKING STITCH is used mainly to hold material in position until it can be sewn, but this stitch also makes a decorative EMBROIDERY



Example of tacking stitch

border Begin with a knot if the tacking is to be taken out later, if used decoratively, secure it with a BACK STITCH on the wrong side of the material

TANAGER. See CAGE BIRDS

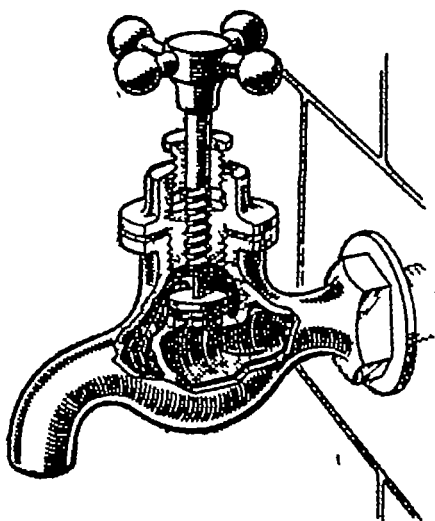
TANGANYIKA is a former German colony in East Africa, now governed by Britain See MANDATE Native agriculture and stock-rearing are well developed, and sisal, coffee, cotton and hides are exported Groundnuts are being widely grown A few white settlers live in the region around the extinct volcano Kilimanjaro The chief town and port is Dar-es-Salaam See the map of AFRICA

TANGENT. See CIRCLE

TANGO, a dance originating in Mexico, and now danced all over the Spanish-American countries In a very modified form it is danced in European ballrooms

TAOISM is a Chinese religion supposed to have been first taught by Lao-tze, who lived in China in 600 B C and is credited with having written a famous book, the *Tao Te Ching*, about "Tao," which means "the Way" He taught men to be unselfish and not to judge others In later centuries Taoism became largely a matter of spells and magical practices

TAP, a controlled outlet from which liquid or gas can be drawn off



How the household tap works

When the domestic water tap is screwed down, a metal disk, with a washer of leather or some other substance, closes an aperture and holds the water in. When the tap is unscrewed, the disk rises and the water is able to pour through.

TAPES, TO PUT ON Tape is much used on clothing and household articles. It is neat and strong and the same on both sides, and except at the ends has no raw edge. It may be sewn on the right or wrong side of material or garment as required.

When you sew tape on the wrong side of an article, make the tape secure by sewing a length of it equal to the width of the tape or longer if the tape is very narrow, then OVERSEW along the edge of the garment with the right side towards you, next turn to the wrong side of the material and HEM along the three sides of the tape, turning under the free end of the tape to prevent it curling up. Finish with a BACK STITCH or two.

If the tape is to be sewn on to the right side of the garment, oversew all round instead of hemming.

To sew a loop on to a towel, mark off two squares on the tape ends. Sew the ends together and place where required. Attach the ends as for the wrong side of material and finish.

TAR is a heavy viscous black material obtained in the DISTILLATION of wood and coal. It is used for waterproofing fabrics, wood, and road surfaces.

TARTAN, woollen cloth with various patterns of horizontal and vertical stripes, used for the distinctive dress of the Highlanders of Scotland.

TARTAR, a term applied to mixed Asiatic races inhabiting parts of Siberia, Turkestan and the Russian steppes (treeless plains).

In the Middle Ages the Tartars included the warriors of Mongolian and Turkish origin, followers of Genghis Khan ("Very Mighty Ruler"), the Mongol conqueror, who in the 13th century had overrun Northern China, and carried his conquests across Asia to the Persian Gulf and the Caspian Sea. He died in 1227, and was succeeded by his son, whose nephew, Batu,



The Tartars attack

led the Tartar hosts which invaded Russia, ravaged Moravia and Silesia, took Cracow and threatened Vienna. They were then turned back by the bravery of the Germans, Czechs and Poles. But for two centuries, the Tartars of the Golden Horde (they were a yellowish people) occupied the lower Volga and the south-eastern steppes, forcing Russian princes and city republics to pay heavy tribute.

Kublai Khan, the grandson of Genghis, completed the conquest of China, and had his capital at Peking. He was the first foreigner to rule over China. His Mongol Empire at one time extended from the Arctic to the Strait of Malacca, and from Korea in the Far East to Asia Minor and the borders of Hungary. The splendours of his court are described by MARCO POLO. Kublai died in 1294.

TARTARIC ACID is a solid organic acid made from "cream of tartar," a substance obtained from wine-vats. It is used in baking powder (SODIUM bicarbonate) and many effervescent drinks.

TAXATION is the raising of money from the citizens to pay the costs of government, military protection, social services, etc. Taxes are proposed by the Chancellor of the Exchequer and must be passed by the House of Commons. They are of two kinds.

(1) *Direct Taxes* are those which citizens pay directly to the Government, such as (a) income tax and (b) death duties.

(a) Income tax requires the payment to the Government of a proportion of one's annual income, whether drawn from wages, salary, ownership of property, interest on shares, etc. The proportion to be paid by each person is fixed in accordance with a graded scheme by which the larger incomes pay a

greater proportion than the smaller incomes.

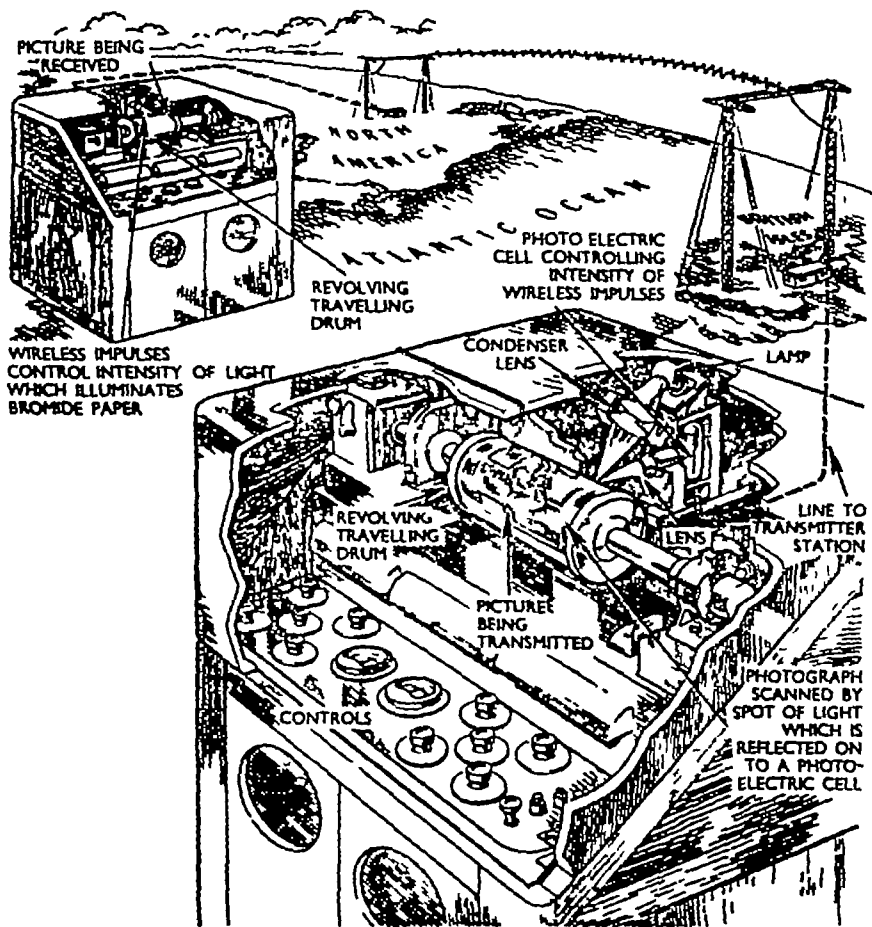
(b) Death duties are payable on the value of the estate (i.e. the possessions) left by a person who has died, the amount varying with the value of the estate.

(2) *Indirect Taxes* are paid indirectly on goods purchased, etc. For example, Customs duties are payable on imported goods such as tobacco, sugar, silk, etc. This tax is paid by the importer, but he adds it to the price the shopkeeper pays, so it becomes part of the price you pay. Excise duties are those on goods or articles manufactured in this country, such as beer and spirits. Entertainment and purchase tax and money for licences also fall under this head.

TCHAIKOVSKY, Peter Ilich (1840-1893), probably the best known Russian composer. Formerly a civil servant, he devoted himself to music and was later helped financially by a wealthy woman music-lover whom he never met. Many of his works, like the Piano Concerto in B flat minor, the Fourth, Fifth and Sixth ("Pathétique") Symphonies, and the "Swan Lake",



Tchaikovsky, Russian composer



How pictures are sent by wireless telegraphy to distant places

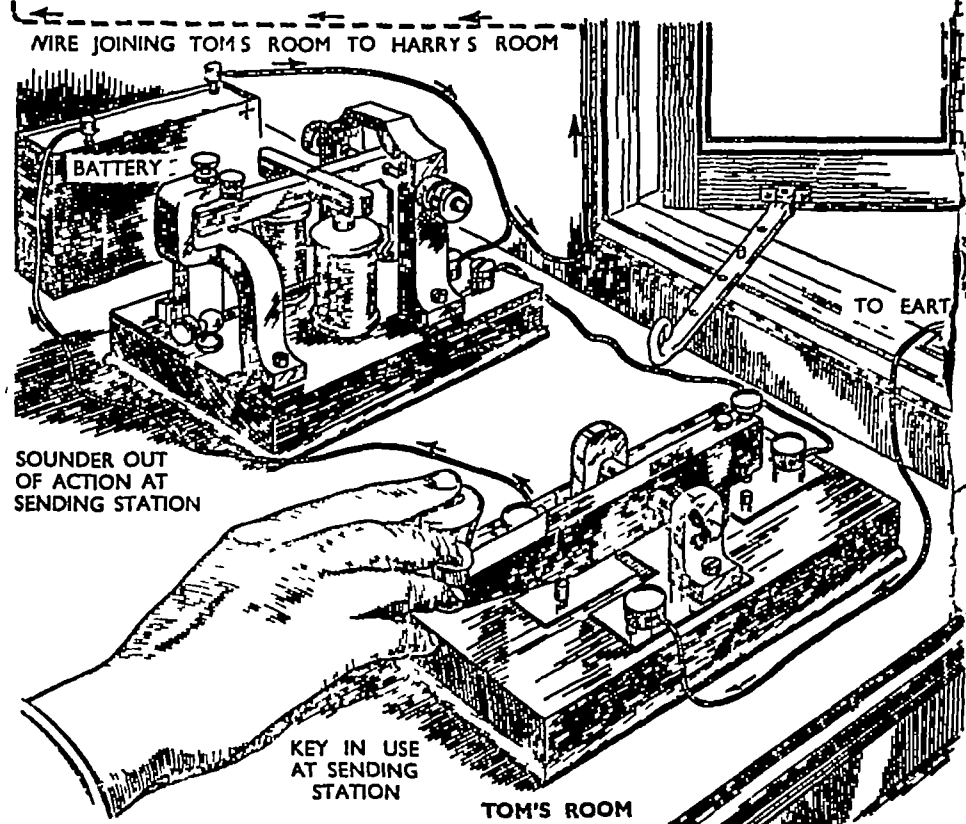
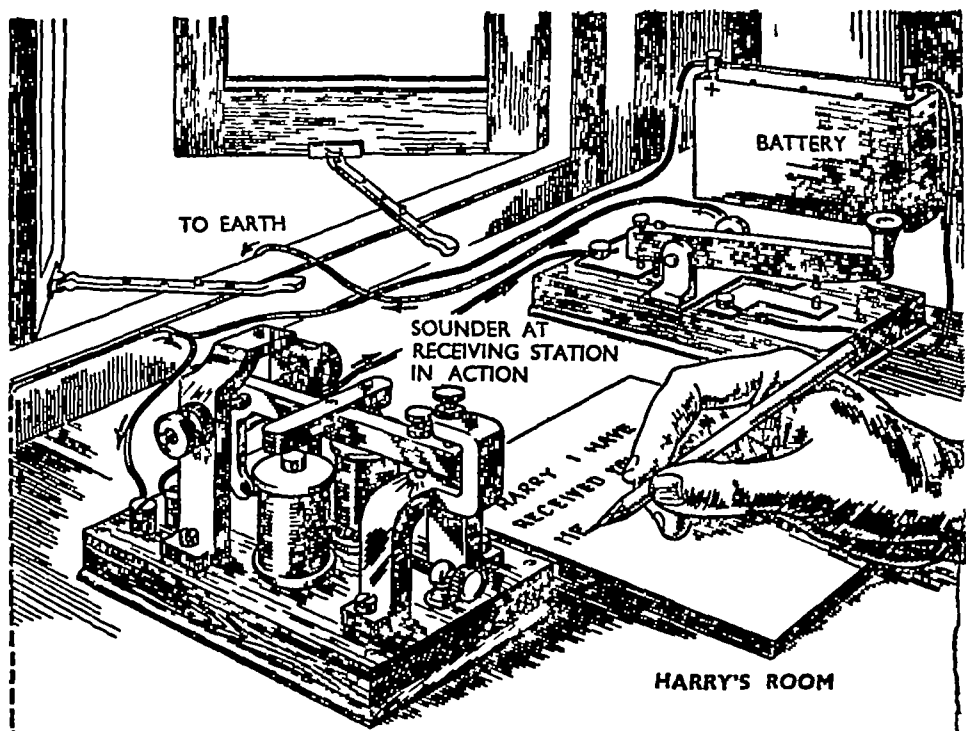
and "Nutcracker" ballet suites, have now become firmly established in the affections of the public.

TELEGRAPHIC TRANSMISSION OF PICTURES.

To send a picture by TELEGRAPHY, it is fastened on a rotating travelling cylinder and scanned by a small pencil of light which slowly covers the whole of the picture bit by bit as the cylinder rotates and moves along. A PHOTO-ELECTRIC CELL is affected by the amount of light reflected from the picture at any one time, this amount depending upon the lightness or darkness of the point being scanned. The

light falling on the cell controls the size of the current which is sent along the telegraph line or is wireless through the air.

At the receiving end a somewhat similar apparatus is used. A light, the intensity of which is controlled by the transmitted current, is focused upon a piece of photographic-sensitive paper on a cylinder. The cylinder rotates and moves along, all in step with the transmitter. By this means there is reproduced upon the sensitive paper, after developing, an exact copy of the original picture on the transmitter cylinder.



These two boys can send messages by telegraph to each other—the picture shows the circuit, including keys, batteries and sounders

TELEGRAPHY is a method of sending signals by means of electric currents through a wire. The illustration shows that when the key at the sending end is depressed, a current flows through the wire to the receiving end. Here the current operates either a light or a BUZZER (otherwise called a sounder) for as long as the key is held down. Signals are usually composed of the short and long impulses which form the MORSE CODE. The circuit shown allows messages to be sent in either direction if a key is not being used for sending, the current from the other end can go through the back-stop or contact and operate the buzzer.

In automatic telegraphy a message for transmission is typed on a keyboard which turns the message into groups of dots perforated in a strip of paper. This strip is then passed through an electrical transmitter which automatically telegraphs the message at high speed along an electrical circuit to a distant receiver. Here the electrical impulses are magnified and then used to operate a special typewriter, which types the message in ordinary letters and figures.

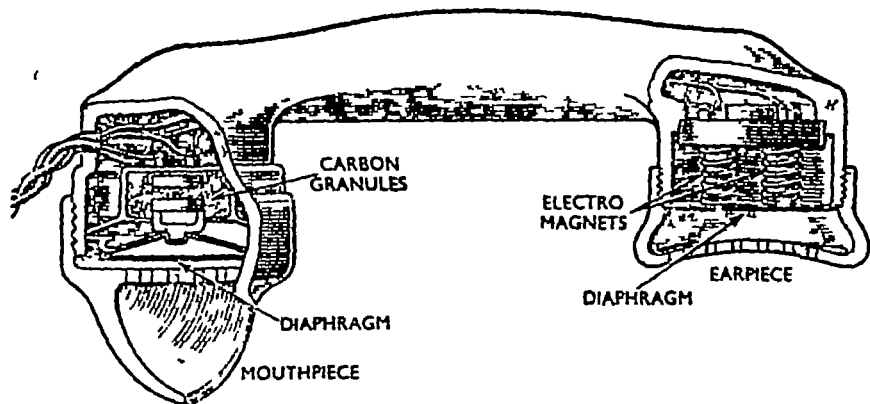
In WIRELESS telegraphy, trains of waves are sent out by a transmitter

for long or short periods. These are picked up and turned into sound signals at the receiving end.

See also **TELEGRAPHIC TRANSMISSION OF PICTURES** and **TELEPRINTER**.

TELEPHONE, a means of communicating speech by electric currents. The sound waves of the voice enter the mouthpiece and strike a microphone containing carbon granules behind a thin sheet of metal, the vibrations of this sheet of metal, the diaphragm, cause compression of the granules, which alters their resistance to an electric current. So a varying current results which is carried by a wire to the receiving end where it passes, in the earpiece of another telephone, into an **ELECTROMAGNET** and vibrates an iron diaphragm fixed in front in accordance with the variations in the current. The vibrations of this diaphragm produce sound waves similar to those which originally fell on the microphone of the telephone at the other end of the wire.

TELEPRINTER, a telegraphic instrument which conveys messages in printed form. It has two parts, the transmitter and the receiver. The transmitter has a keyboard similar to a typewriter keyboard, and the depression of a key on this



The telephone changes sound into electric current and back again to sound

keyboard types the required character on a distant typewriter at the other end of an electrical circuit. In the same way, messages from distant keyboards are received and typed on the receiver part of the teleprinter.

TELESCOPE, an instrument which by means of optical lenses gives to an observer an enlarged view of a distant object. The first lens produces an image upside down, and this image is then enlarged by a magnifying glass. For inspecting objects on this earth, this image must be turned the right way up by means of another lens, or pair of prisms as in binoculars, before being magnified. As more light is collected by the first lens of a telescope than by the naked eye, the telescope image will be brighter.

The astronomer often lets images too faint for the eye fall upon photographic plates, and thus obtains photographs of stars which have never been seen.

TELEVISION. Consider a still picture, a scene with no motion. This can be split up into a large number of parallel strips, each of which can be considered as a succession of light and dark portions. If we can arrange a PHOTO-ELECTRIC CELL so that the light from each part of the strip is concentrated upon it in turn, then we shall get from the cell a current which

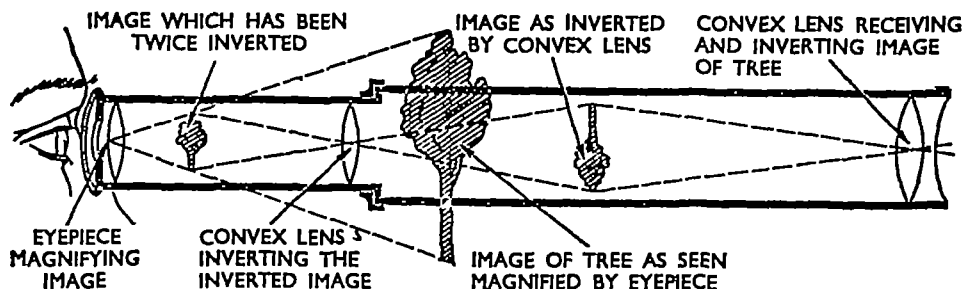
varies in accordance with the shading of the strip. When one strip has been dealt with, the light from the next is thrown on the cell, a portion at a time from one end to the other of the strip, and so on for all the strips. This process is called scanning.

The latest television camera receives an image of the scene to be televised upon a special screen, composed of a large number of photo-electric cells. In a very short space of time the screen is scanned or, in a sense, inspected by a beam of electrons which is produced and controlled automatically by another part of the camera.

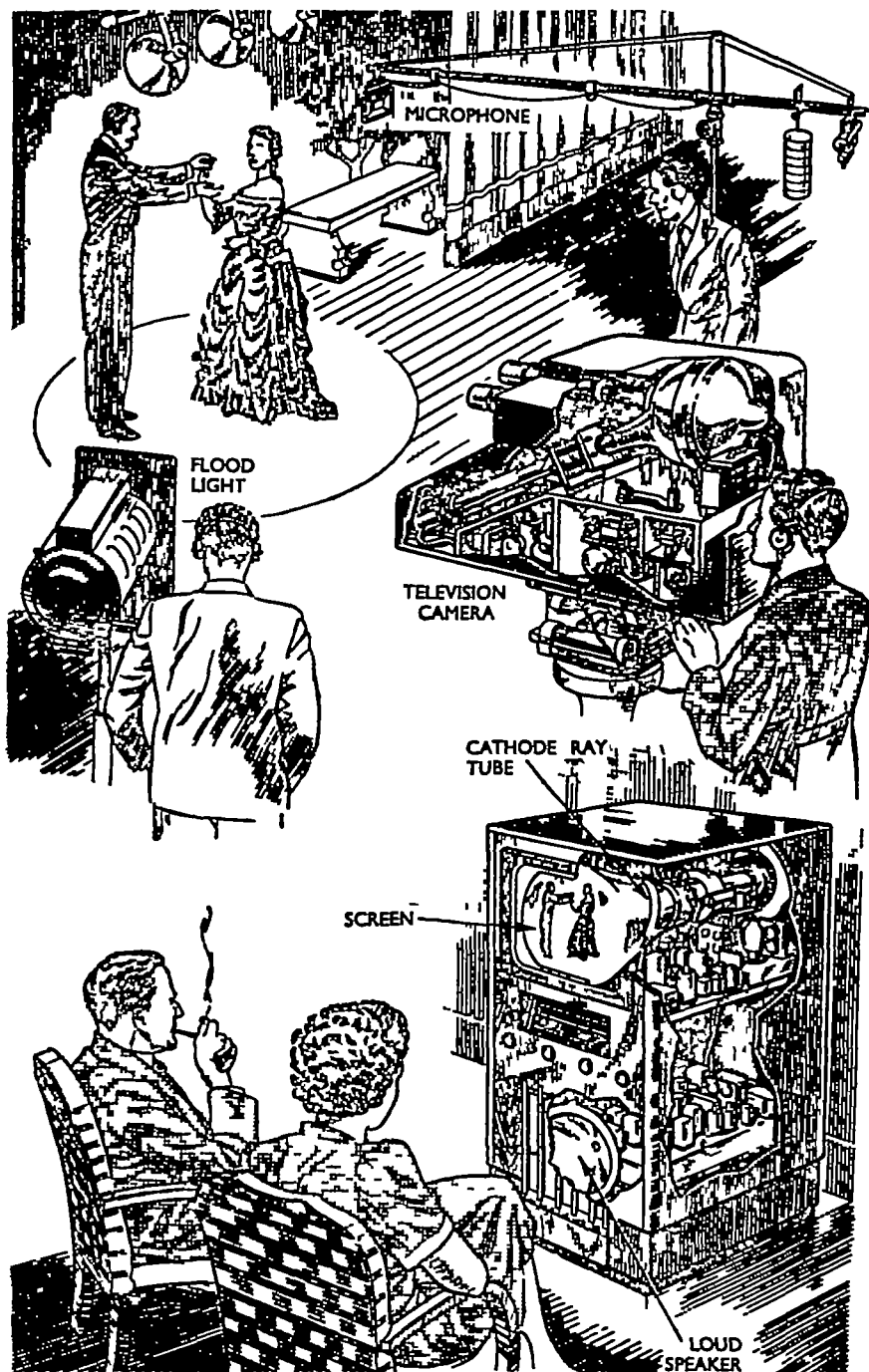
At any one point of the image the current which is generated by the electron beam as it passes depends upon the brightness of the illumination of the photo-electric cell at that point.

Thus, in the way mentioned above, the picture is translated into a current of varying size which can be transmitted through the air to a receiving set.

In the latest receiver the picture is rebuilt upon the screen of a cathode ray tube. The screen is scanned at very high speed by a moving beam of electrons which causes a spot of light where it strikes the screen. The brightness of the spot is controlled by the strength of the received signal. The effect on the eyes is of a complete



The telescope's lenses give an enlarged image of a distant object



The television camera turns the light and shade of what is going on in front of it into an electric current of varying strength, this current is broadcast to home receiving sets which turn it back into moving pictures

picture So the original scene, having been transformed into an electrical current of rapidly varying strength, is now reconverted into a visible moving picture

TEMPERATURE, the degree of hotness of a substance, or of any particular point on the earth's surface depending on the altitude of the sun, duration of daylight, height above sea level, distance from the sea, aspect, prevailing winds, and amount of cloud Temperatures vary from hour to hour They are measured by **THERMOMETERS** At meteorological stations temperatures are taken at stated times throughout the day, and the maximum and minimum readings are recorded Average daily, monthly and yearly figures are calculated and used in the construction of weather and climate maps See **METEOROLOGY**

TEMPLE, the sacred building at Jerusalem where the Israelites worshipped God and offered sacrifices **SOLOMON** built the first Temple, which was destroyed when the Babylonians carried the people off to exile The Temple which the

people built when they returned was pulled down by Herod twenty years before Christ came, Herod built his own Temple, but this was destroyed in A D 70 The **GREEKS** and **ROMANS**, too, built many fine temples

TENNIS. See **LAWN TENNIS**

TENNYSON, Alfred, Lord (1809-1892), was educated at Cambridge where he met Arthur Hallam, who became his closest friend His earliest verse appeared in 1827, with some by his brother, Frederick In 1830 appeared a volume of his own verse, *Poems, chiefly Lyrical* In 1833 Hallam died, and Tennyson began *In Memoriam*, a poem, or rather a long series of poems, celebrating his friendship and his sense of personal loss In 1833 a further collection of poems appeared, and, in 1842 a complete edition of all his poetry so far This included "A Dream of Fair Women," "The Lady of Shalott," "The Lotus-Eaters," "Ulysses," and "Morte d'Arthur" In 1847 he published *The Princess*, a long poem containing some of his best-known songs, such as "Now sleeps the crimson petal," and "The splendour falls on castle walls"

1850 saw him **POET LAUREATE**, in succession to Wordsworth *In Memoriam*, now finished, was published in this year As Poet Laureate he wrote verses on national events, such as the "Ode on the Death of Wellington" In 1884 he was made a peer, and upon his death he was buried in Poets' Corner, in Westminster Abbey His other works include "Maud," "Idylls of the King," "Enoch Arden," "The Ballad of the Revenge" "Crossing the Bar"

TERMITE See **BEE**

TESTAMENT. See **COVENANT**, **NEW TESTAMENT** and **OLD TESTAMENT**



Tennyson, Victorian poet



Thackeray, Victorian novelist

THACKERAY, William Makepeace (1811–1863), English novelist

Until he went to Paris in 1833 to study drawing, Thackeray had not settled to any particular work. He returned to England in 1837, and wrote the *Yellowplush Papers* in which the reader views the great from the point of view of their footmen. In 1842 he began to write for *Punch*, his contributions including the articles appearing in 1847 as *The Book of Snobs*, an attack on social snobbery. *The Luck of Barry Lyndon* purports to be the autobiography of an infamous scoundrel who sees nothing wrong with himself—a piece of irony from start to finish. But his principal novels are *Vanity Fair*, *Pendennis*, *The Newcomes* and *Esmond*. In these he depicts people, not with the exuberant, tolerant humour of Dickens, but with a critical eye seeing both good and bad qualities in the same person. He is a realist.

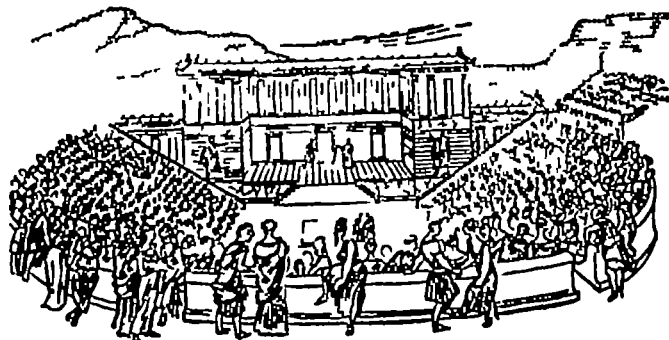
THAILAND. See **SIAM**

THEATRE, a building specially designed and equipped for the performance of plays. Theatres have existed in England since the reign of Queen Elizabeth, the first permanent theatre, simply called

"The Theatre," being built during her reign in London. Buildings designed for plays are, however, far older than this and remains can still be seen in Greece, notably at Epidaurus, of theatres built long before the Christian era.

In England, before theatres were built, plays were first performed in church as part of the service, being dramatized versions of Bible stories. Then these plays were performed on wheeled platforms called pageants (See **DRAMA**). Later bands of strolling players took to performing them in the courtyards of inns. An inn was usually built so as to enclose an open square into which carts and coaches with travellers were drawn through a narrow passage. Wooden galleries ran along the inner walls of the inn looking down upon the yard, and spectators could use these galleries to view the play while others crowded the yard itself, at one end of which the acting took place.

When men thought of erecting a building specially for the presentation of plays, naturally they followed the design of the inn yards. The first theatres—those that Shakespeare himself knew—were usually circular or square buildings with galleries running round the inside walls, the galleries roofed in from the weather but the floor of the theatre open to the sky and without seats for the audience, who stood in the "pit." The stage had more depth from back to front than today, while at the back of the stage was an inner stage, separated from the outer part by curtains which could be drawn back to give extra depth. Above the inner stage was a balcony, used in plays—as in *Romeo and Juliet*—whenever the stage direction was given, "Enter above." Above the balcony was another storey, popularly called



Greek Drama



English Drama
Began in Church Service



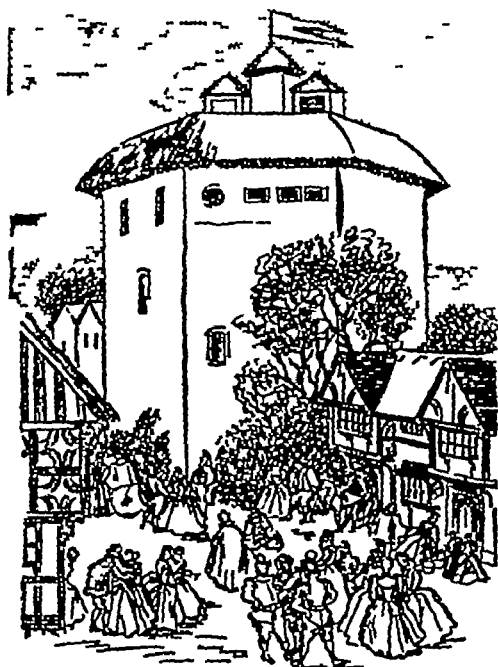
Inside the Elizabethan Theatre



18th Century Stage

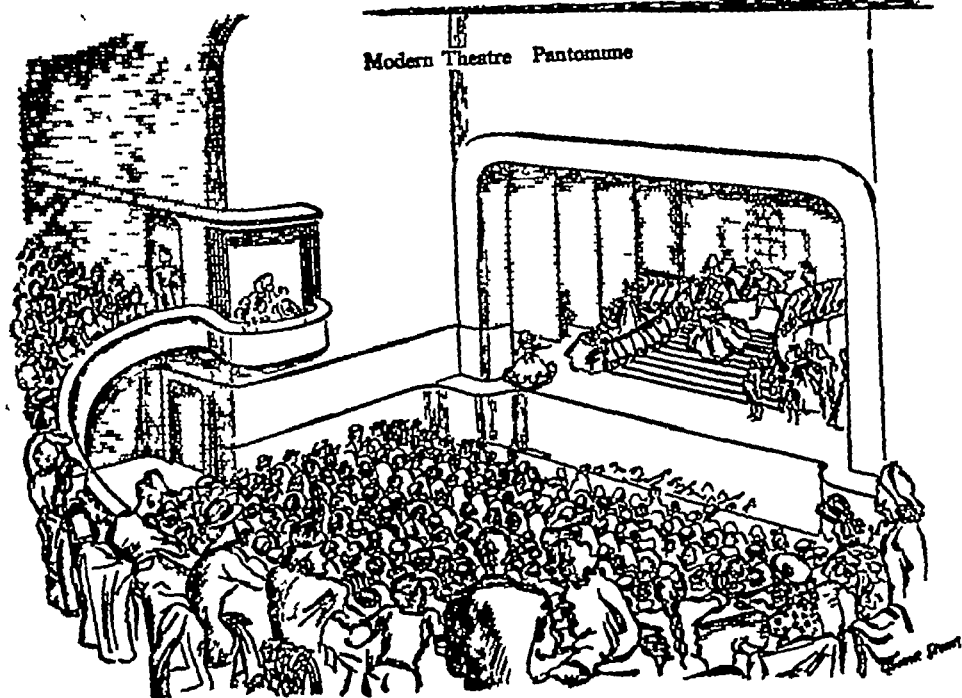
The Ancient Greeks had theatres, but drama in England began in brief dramatized versions of Bible stories performed in church, these playlets were

Miracle Play on
Movable Stage



Early Elizabethan Theatre—the 'Globe'

Modern Theatre Pantomime



later performed on movable stages The first theatres, small and partly open to the sky, have developed into the spacious covered buildings of today

the heavens," where furniture was stored, theatre property kept, and actors dressed. No curtain divided the stage from the audience, so all stage furniture had to be arranged in public. There was no lighting, and no scenery to speak of—the Elizabethan author describes the scene in the speeches of his characters, for the rest the audience must use their imagination more freely perhaps than we do today. Costumes, however, were highly elaborate and colourful.

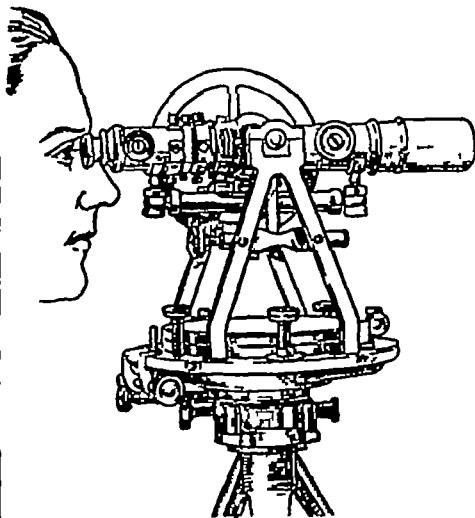
During the following centuries the theatre developed in size, grew a roof, was lit artificially, first by candles, then by gas, and lastly by electricity, and its orchestra settled itself in a pit in front of the stage.

The modern theatre is usually designed for the comfort of the audience. Curtains, which are lowered at the end of acts, make it possible to change settings from act to act. A steel safety curtain, which must be lowered once during each performance, makes it possible to cut off the stage from the rest of the theatre in case of fire, and all stage hangings must be rendered fireproof. The stage slopes upwards from the audience, this is shown in the directions "upstage" and "downstage", meaning towards the back and the front of the stage respectively, some producers use a revolving stage to facilitate scene-changes. The stage is lit up by powerful electric lights, arranged in battens on the roof of the stage, with powerful floodlights—limelights—at the corners, all shining downwards. Footlights, too, are placed on floor-level, or slightly below it, at the front of the stage, directed upwards on to the faces of the actors. Concentrated beams of light called spotlights, arranged at the back of the theatre and often half-way back, can be

adjusted to throw a still stronger light on the actors. These lights are covered with coloured gelatine, so that different lighting effects can be achieved by a combination of different shades.

Such powerful lighting makes it necessary for the actors to use make-up, as their natural colouring would look unnaturally pale.

THEODOLITE, a **TELESCOPE**, mounted on a firm tripod stand, which turns round and up and down and can be used to measure angles



Theodolite for measuring angles

in both horizontal and vertical planes by noting the amount of turning needed to bring it to bear on a distant feature.

THERMIONIC VALVE. See **VALVE**.

THERMITE is a mixture of aluminium powder and iron oxide, which when ignited burns with great fierceness and produces molten iron. It is used for welding steel and as a filling for incendiary bombs.

THERMOMETER, an instrument for measuring **TEMPERATURE**. The illustration shows the mercury thermometer, in which the increase in volume of the mercury in the

bulb, caused by a rise in temperature, is forced to take place along a fine glass tube. The distance the mercury thread travels along the tube shows how hot the bulb is. The scales used are Centigrade, Fahrenheit, and, rarely, Réaumur.

THERMOSTAT, a device which controls the heating apparatus so as to keep a TEMPERATURE at a given place constant and steady. One type uses a THERMOMETER which, when the mercury reaches a certain height, switches off the heating current and allows the surroundings to cool, switching on the heating again when the temperature falls too low.

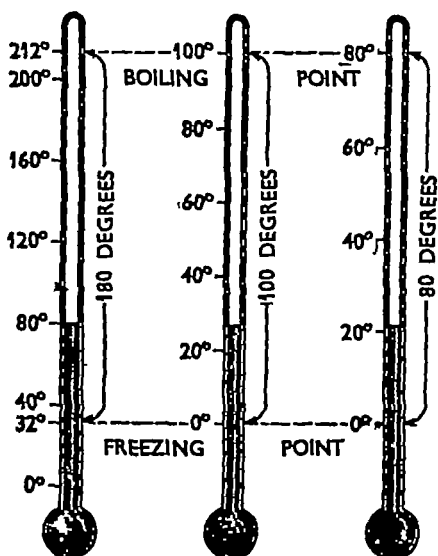
THESEUS is in CLASSICAL MYTHOLOGY the Greek hero who slew the MINOTAUR of Crete.

THINNING OUT in gardening is the operation of removing a proportion of the SEEDLINGS so that those remaining will have room to grow. The largest and strongest seedlings should be allowed to remain and the more backward ones should be pulled out to make more room. If the latter are seedlings which can be replanted in another part of the garden, they should be lifted from underneath with as much soil as possible still clinging to the roots. This is called transplanting. See SEED-SOWING.

THIRTY YEARS' WAR (1618-1648), mainly a struggle between Protestantism and Roman Catholicism. It began when the Protestant Bohemians rebelled against the Emperor Ferdinand, the head of the Catholic League. The Bohemians offered their crown to Frederick, the Elector of the Lower Palatinate, and son-in-law of James I of England.

The Emperor invaded Bohemia, defeated Frederick and drove him out, and also invaded the Palatinate. His armies swept all before

FAHRENHEIT CENTIGRADE RÉAUMUR



Three thermometer scales compared

them Christian IV of Denmark tried to help the German Protestants, but was forced to make terms at Lubeck (1629).

Then a new Protestant champion came forward, Gustavus Adolphus of Sweden. He crossed to Pomerania with 15,000 men, drove the imperial troops away and took Stettin. The French Minister, Cardinal Richelieu, not wishing to see the Emperor grow more powerful, sent money to help the Swedes, who in due course marched in triumph to Munich. In November, 1632, Gustavus Adolphus was killed at Lutzen, near Leipzig, though the Swedes, maddened by the loss of their leader, fought desperately and finally won the battle.

In 1648 the Emperor agreed to the Peace of Westphalia, and the war ended, the most disastrous for Germany till the Second World War again laid it in ruins.

THISBE See PYRAMUS.

THOMPSON, Francis (1859-1907), who gained fame as a poet, began by studying medicine, but ill-health reduced him to destitution Alice MEYNELL, the poetess, and her husband Wilfrid, who befriended many struggling writers, rescued him just in time His *Poems* include "The Hound of Heaven," a religious ALLEGORY Other works include *Sister Songs*, *New Poems* and an *Essay on Shelley*

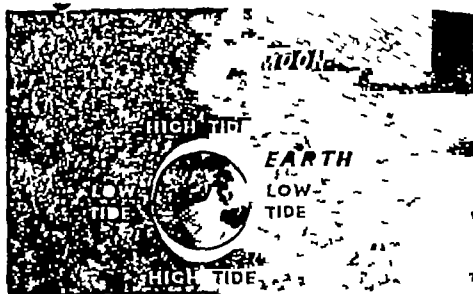
THOR is in Old English and Norse MYTHOLOGY the god of thunder and war Thursday is named after him

THRUSH, a resident British BIRD of gardens and hedgerows, singing in every month except August It hops and runs as it hunts worms and snails The back is brown and the breast speckled The song-thrush is related to the larger missel-thrush or storm-cock, so called because it continues to sing loudly even in a storm or gale See picture on page 77

THUNDER is the noise caused by the sudden expansion and contraction of the air which occurs when it is suddenly heated by the passage of the electric current during a flash of LIGHTNING

TIBET is a mountainous state north of the Himalayas In theory part of China, in practice it is controlled by Buddhist monasteries ruled by lamas The Dalai Lama, or chief priest, lives in Lhasa, the capital Wool and salt are exported, but Tibet has little contact with the outside world See map of CHINA

TIDES, rise (flow) and fall (ebb) of the sea caused by the attraction of the moon and sun and occurring about twice in every twenty-five hours The tidal range, the difference in level between high and low tide, varies with the phases of the moon The highest tides are at



Moon causing high and low tides

full moon and new moon (spring tides) and the lowest at half moon (neap tides) The spring tides of full and new moon occur when the earth, moon and sun are in line, neap tides occur when the pulls of the sun and moon are at right-angles See GRAVITY

TIGER. See CAT

TIMOR. See EAST INDIES

TIN is a soft metallic ELEMENT, which melts at a fairly low temperature It is not rusted by damp, and is therefore used for tinplate, thin sheets of iron or steel covered with a layer of tin to preserve them from rusting

TINPLATE. See TIN

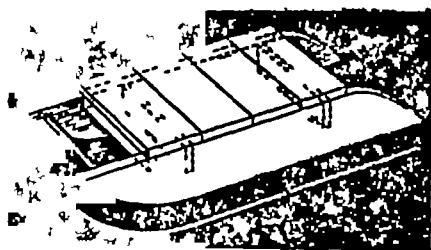
TIT, a family of small, acrobatic BIRDS of which the great and blue tits come readily to feed if fat or nuts are hung up The great tits are larger, with a black stripe down the underside, and white cheeks Coal tits and longtailed tits frequent woods Pictures on page 77

TTTANS are in CLASSICAL MYTHOLOGY an older giant race of gods who were overthrown by JUPITER See SATURN

TOAD. See FROG

TOADSTOOL. See FUNGUS

TOBOGGANING is the sport of careering down snow-covered hills on a wooden toboggan or sledge, which can hold one or several people The model shown here is a single-seater, but it could be longer if necessary It is made



This toboggan is easy to make

out of broad, thick pieces of wood for the seat, short pieces for the cross-bars, and two stout lengths for the runners which are shod with strips of barrel iron. A rod from a broomstick, sunk into each side, serves as a rest and guide-rail for the feet.

TOCCATA, a piece of music designed to show off the agile "touch" of a performer.

TOLSTOY, Leo Nikolaievich, Count (1828-1910). Of the Russian novelists, Tolstoy has the broadest canvas. His *War and Peace* combines the study of many characters with a panoramic picture of Napoleon's invasion of Russia. *Anna Karenina* is a penetrating story of unhappy marriage. Tolstoy is a moralist with strong sympathy for the oppressed and an understanding of humble people no less than of the mighty.



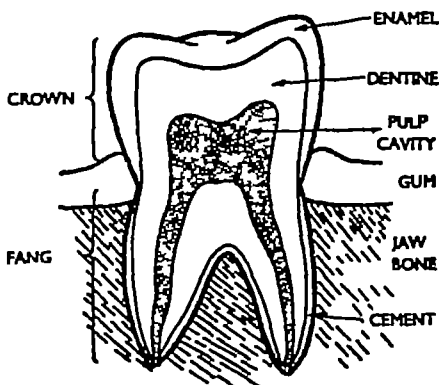
Tolstoy, Russian author

TONIC SOL-FA See **NOTATION (MUSICAL)**

TOOLS *Hand tools* are implements made of wood and metal for assisting a person to alter the shape of, or fix together, materials of many descriptions, e.g. saw, chisel, plane, hammer, as shown in the illustration on page 580.

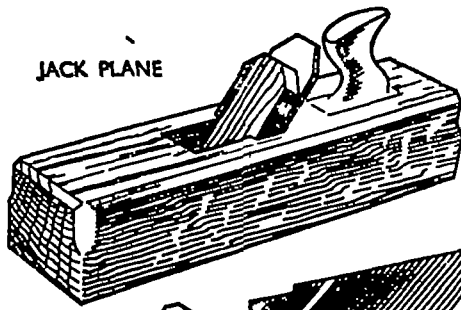
Machane tools are tools worked by power instead of by hand or foot, and include the power hammer, the circular saw, power press, drilling machines, etc., as shown in the illustration on page 581. See also **METAL (FABRICATION OF)**, **WOOD (FABRICATION OF)**, and **WOODWORK**.

TOOTH, a structure growing from the jaws of vertebrate animals.

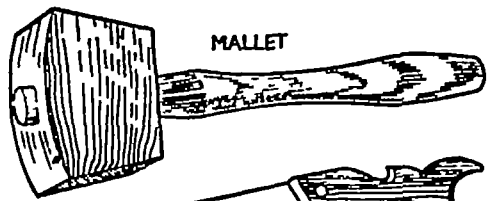


Parts of a tooth

Mammals' teeth are fastened in sockets by bony cement. The first set, milk teeth, are soon replaced by the fuller permanent set. Each tooth is made of dentine, covered with harder enamel. The roots are open during growth, blood vessels and nerves penetrating the dentine. Incisors (cutting teeth), canines (eye teeth), pre-molars and molars (cheek teeth) are developed in relation to each animal's method of feeding. In each quarter jaw, humans have two incisors, one canine, two pre-molars and three molars. The last



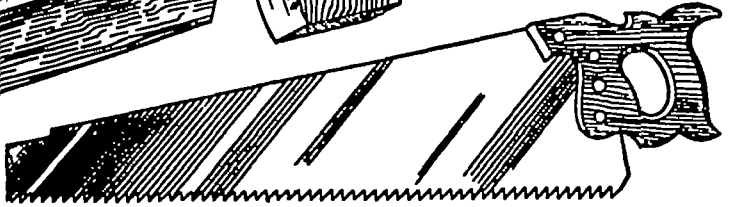
JACK PLANE



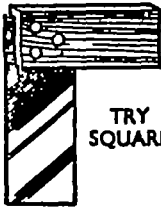
MALLET



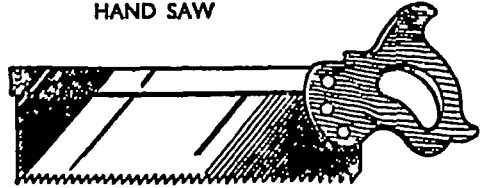
SMOOTHING PLANE



HAND SAW



TRY SQUARE



TENON SAW



SPOKESHAVE



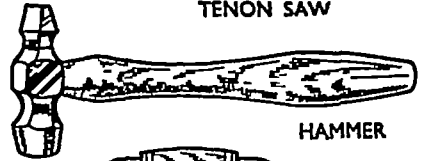
PLIERS



GIMLET



BRADAWL



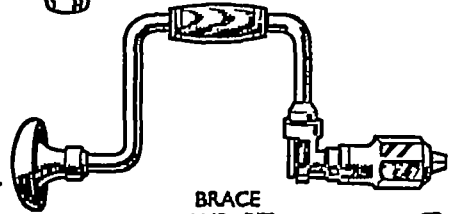
HAMMER



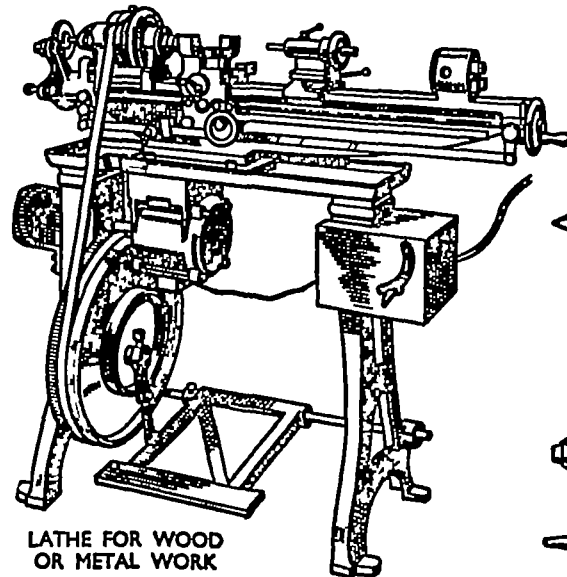
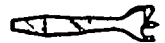
GAUGE



TWO-FOOT RULE



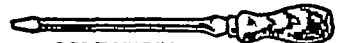
BRACE AND BIT



LATHE FOR WOOD OR METAL WORK



FILE



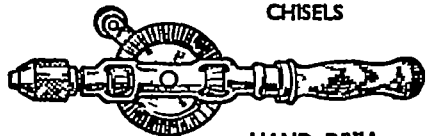
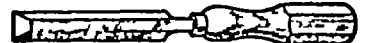
SCREWDRIVER



SOLDERING IRON



CHISELS

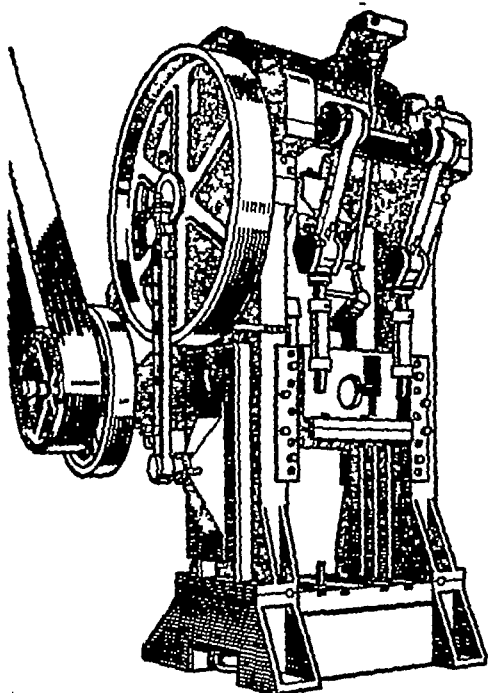


HAND DRILL

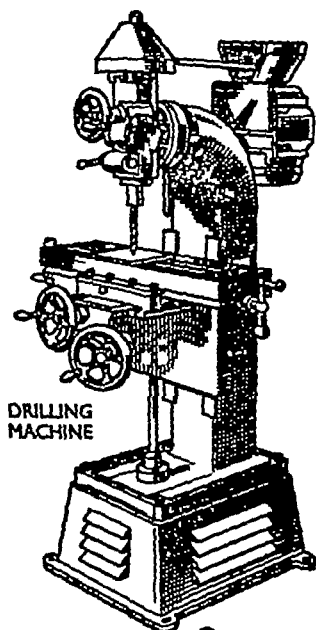


PUNCH

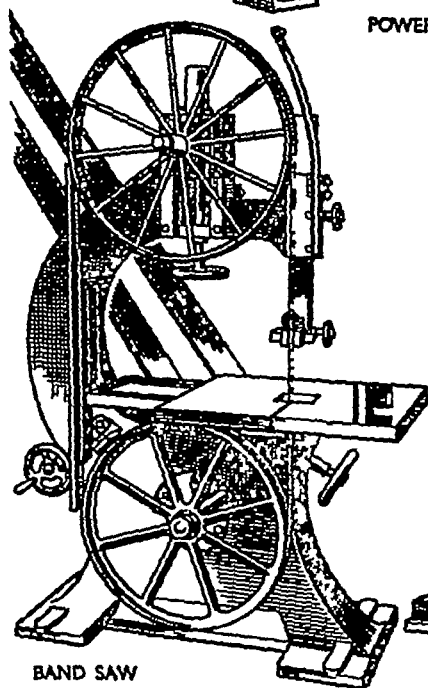
Here is a fairly complete set of tools for the woodworker and general handyman—good tools should be looked after by being kept clean, sharp and oiled, and always put away in a proper box after use



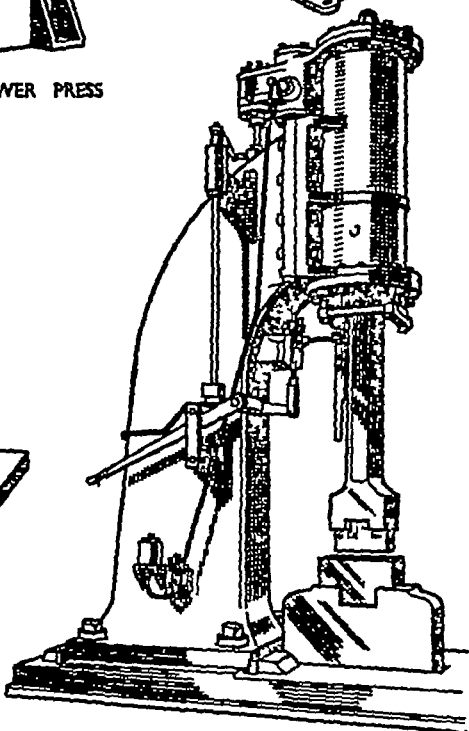
POWER PRESS



DRILLING
MACHINE



BAND SAW



POWER HAMMER

In factories and workshops where large and heavy materials have to be fashioned into shape, machine tools are necessary—they are power-driven and quickly do work that might take many men many days to finish

molar or wisdom tooth is not always visible Dogs and cats have large canines to catch prey, and cud-chewing animals have broad, grinding surfaces to their cheek teeth Tooth decay is partly caused by BACTERIA which feed on decaying food, causing caries by attacking the enamel Regular cleaning helps to keep the bacteria at bay Lack of calcium and vitamins and other bone-forming substances in the diet make teeth liable to decay

TORIES and **WHIGS** were both once terms of contempt applied by men of one political party to their opponents The term "Whigs" (once meaning rebel Scottish Presbyterians) was first applied to Petitioners who petitioned the king to call a Parliament, whereas the term "Tories" (once meaning rebel Irish Catholics) was given to Abhorrrers who abhorred interference with the king's prerogatives Then in the reign of Charles II emerged two political parties to whom the names "Tory" and "Whig" were applied the Tories were a Court party formed from courtiers who were devoted to the Crown and the Church of England, the Whigs were a Country party formed in opposition to the Court party The parties came into prominence during the Exclusion Bill debates(1679-1681) Whig and Tory were the names of the two political parties down to the Reform Bill of 1832, when the names were changed to those of Liberal and Conservative

Today Conservatives maintain that government should guide rather than direct people's activities, and that the making and marketing of goods should remain in the control of individuals moved by the normal desire for gain, though checked by regulations to prevent abuses Liberals stress equality of oppor-

TERRAPIN
(FLESH-EATING)

EUROPEAN
TORTOISE
(VEGETARIAN)

SNAKE-
NECKED
TURTLE

HAWKS BILL
TURTLE

GIANT TORTOISE OF
GALAPAGOS WEIGHT 500 LB

Tortoises and turtles

tunity and personal freedom but would go further than the Conservatives in using government to curb abuses arising from unfettered competition

TORTOISE and TURTLE, REPTILES whose bones together with horny skin shields form a protective case, into which the head and neck, tail and four legs can be partly withdrawn. The case is covered with horny scales, and the toothless jaws with a horny beak The European tortoise is kept as a pet It eats chiefly vegetable food, HIBERNATES in winter, and may live to a great age

Turtles are related marine animals, swimming with flippers Turtle soup and tortoiseshell are obtained from two different species, the latter from the Hawks Bill turtle

TORTOISE AS A PET Though no one could call them vivacious,

tortoises make interesting and amusing pets

Keep them on the grass in a run made of boards about a foot wide to enclose 5 feet by 5 feet and sink a shallow pie-dish of water in the ground. Tortoises love water but they cannot swim. Have a small heap of sand near one corner for them to burrow in and a covered box with straw for them to sleep in at night.

In winter, when they hibernate, put them in a box of straw in a sheltered outhouse. It must not be too warm, a greenhouse or frame, for example, will kill a hibernating tortoise.

Feed them on cabbage, dandelion and lettuce leaves, clover, slices of raw carrot, fruit and an occasional tiny scrap of raw meat. All food must be fresh, and uneaten parts removed.

TOTALITARIAN STATE, one such as prewar Germany or Italy, in which the government is not controlled by the people, but the people by a pyramid of rulers who have seized power with the help of their armed political party. At the top of the pyramid of rulers is a single man—the Leader or Dictator—who takes upon himself all the powers of parliament and more, and who demands the total strength and blind obedience of the people in the name of the State. Political differences cannot be tolerated, any people likely to oppose him, such as men of democratic ideas, are exiled, imprisoned, starved, worked to death, or simply killed. Open criticism is intolerable to the dictator and therefore dangerous to the life or liberty of the critic.

TOWN or BOROUGH COUNCILS are the bodies responsible for the government of towns and cities. The Council as a whole is

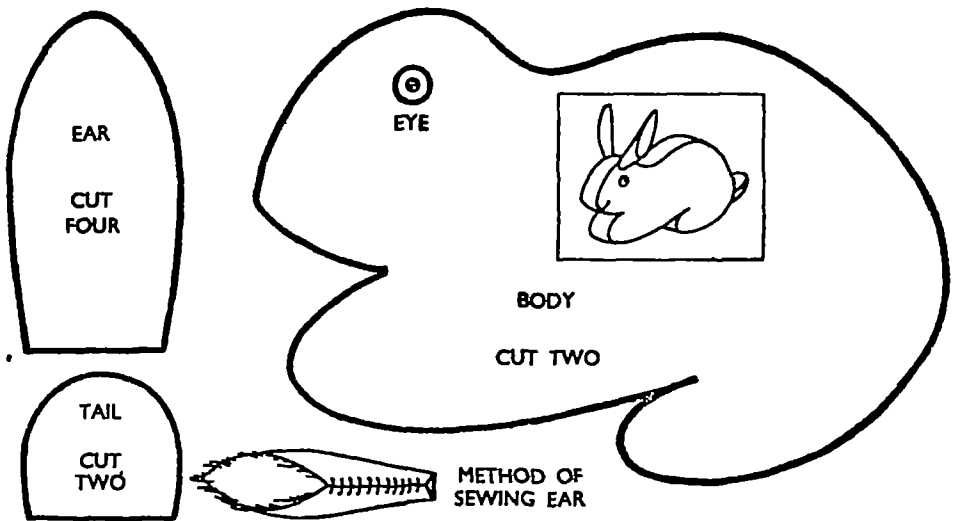
often spoken of as a Corporation or Municipal Corporation. Members of the town or borough council are called the Mayor and Aldermen in England and the Provost and Bailies in Scotland. In some cities such as London, York, Liverpool and Manchester, the chairman of the council is the Lord Mayor, and, in the cities of Glasgow, Edinburgh, Dundee and Aberdeen, the Lord Provost. See also **LOCAL GOVERNMENT**.

Councillors are elected by the local residents for a period of three years. Large towns and cities are divided into wards, each ward being represented generally by three members, one of whom retires each year. Elections are held on or near 1st November, the recording of votes being secret.

Each local body requires a number of trained officials to carry on its work. Some of these are: the town clerk, the city chamberlain or town treasurer, the sanitary inspector, the medical officer, the water engineer, the road surveyor, the education officer, etc., who are assisted by committees of councillors.

Local government needs money to carry on its activities. This is raised by municipal taxes called rates and by grants from the central government. Rates are based not on wages or income but on the estimated annual value of the rate-payers' houses and land. It is the duty of an official called the Assessor to fix the annual value of houses, factories, land, etc., and enter these values in the Valuation Roll. The total given in this Roll is called the Valuation of the town or district, and from it the amount per pound for rates can be fixed.

Revenue is also drawn from municipal undertakings, the surplus from these enterprises being usually



Shape of the pieces of material for making a toy rabbit

placed in a fund for various amenities for the town

TOYMAKING The making of soft toys is very simple, and there are many books with excellent patterns in them. It is possible, however, to make some simple stuffed toys such as stocking dolls without buying patterns.

Any odd material may be used. Velvet, fur fabric, stockinette, blanket cloth, or old pram covers make very good teddy-bears, dogs, rabbits, etc. Oddments from summer frocks, pyjamas or curtains can be used to make clothes for the stocking doll. Pieces that are too small to be sewn can be shredded or cut small for stuffing. American cloth and felt make very good toys, if you are buying new material.

There is no need to make separate legs for all animals. For a crouching rabbit, for example, draw a simple outline, cut two pieces, one for each side, and join them by a long strip which will reach from the tail all round the body and back again to the tail. Take care to sew the strip evenly. The BACK STITCH is useful. If one side is pulled more

than the other the animal may have a crooked face or he may not stand up. An elephant, duck, fish, or horse could also be treated in the same way. If the animal is standing, make his legs square at the bottom and straight at the sides, then the strip can be carried all round him and his legs will be solid.

To make a golliwog or stocking doll, cut two pieces, four arms and four legs. Sew the shapes together on the wrong side. Leave the bottom of the body and the top of the arms and legs open for stuffing. Turn the right way out and stuff. Oversew the bottom of the body and the top of the legs, then oversew them together.

Leave about $\frac{1}{2}$ inch unstuffed at the top of the arm. Place the arm on the shoulder and hem it round. The doll is then ready to be dressed.

To make hair, wool is either sewn on like a wig or, in the case of the golliwog, tufted on in knots. Mark the features, remembering to put the eyes half-way down the face. Coloured felt is effective for the mouth, or it can be embroidered.

Points to remember when making soft toys are.


- (1) Cut your patterns carefully
- (2) If the material has a right and wrong side, turn the pattern over when cutting the second half of the animal or toy
- (3) See that the material all strokes the same way if it is velvet or fur fabric
- (4) Stuff heads, arms and legs first, evenly and firmly
- (5) Tack your pieces together before sewing until you have had some experience in sewing soft toys
- (6) Sew all seams with a strong back stitch or by machine.
- (7) Sew on ears, eyes and tail very firmly


TRACKING is the ability to read signs and clues so that we can tell what has been happening, and, if we are tracking some person or animal, so that we can keep to the trail. Men living in the wilds and detectives need to be able to do this. It all depends on our powers of observation and our mental ability to deduce the right conclusions from what we observe. These qualities can be acquired during our normal everyday life. There is, for example, Kim's game, in which we look at a mixed collection of odd articles, then afterwards try to name and describe as many as we can. When we walk about our town we should notice the names of the streets we pass through, look at the buildings, then try later on to reconstruct the journey in our mind's eye. Stand before a shop window for a minute, notice as much as you can, then turn away and see how much of what is there you can remember, then check yourself to see how much you have missed. When travelling in a bus or train, unobtrusively examine the other passengers, their faces, clothes, gestures, and try to deduce how they earn their living, in the country you can observe footprints, bird and animal tracks on the ground, or the wheel marks

of vehicles in the road, deducing what made the track or mark, when it was made, where the person or thing was going. When a team is tracking something down, they may need to leave messages for one another (Tramps do this outside houses to inform later comers what sort of a reception they may expect!) Here are some useful signs, made with sticks and stones, to which you can add others of your own

gone this way, →

not this way, X

gone home, 

message 3 yards ahead,  →

TRADE See **COMMERCE**

TRADE MARK, a distinctive sign or device or even an invented word or name given to a product. It can be registered so that it cannot be copied. It serves to advertise goods. With some businesses it has become an emblem for fine craftsmanship and sound quality, and thus forms part of the **GOODWILL** of the firm.

TRADES UNION CONGRESS, a voluntary association of **TRADE UNIONS** of Britain, its yearly meeting being attended by delegates from the Trade Unions concerned. The first meeting was held in Manchester in 1868 when delegates from the principal unions met to consider their legal position, as the unions were not satisfied with the laws regulating them. In 1890 Congress decided that the time had come for political action to improve the condition of the working classes. Some members, led by Keir Hardie, wished to form a new parliamentary party and nominate candidates for election to Parliament. Others, and they were in the majority at this time, wished to bring pressure on the old parties by exercise of the voting power of the working classes. Keir Hardie followed his own plan,

was nominated for the East Ham constituency, and in 1892 was elected to Parliament. Three years later there were 29 Labour candidates at the General Election but they were all defeated, including Keir Hardie. Congress, however, was now convinced and the Labour Party was formed in 1900. At the General Election in 1906 it won 29 seats. Keir Hardie's party continued to act independently and became known as the Independent Labour Party.

TRADE UNION, an organization of the workers in a particular trade or industry for their protection in all matters affecting them in their work, such as wages, conditions of service, admission to the industry, etc. Trade unions in Great Britain developed as a result of the conditions created by the Industrial Revolution and their story belongs to the last hundred and fifty years or so. At first they were distrusted on the ground that they might be politically dangerous, and in 1800 such combinations of workers were declared illegal. Twenty-five years later this ban was removed and the way was then open for their development, though there were still many difficulties, legal and otherwise, to be removed before they attained their present position and influence. In the early days they were almost entirely confined to the highly skilled workers, the "aristocracy of labour" as they were called, they were usually local bodies, and frequently also acted as friendly societies. Gradually through the nineteenth century, with the development of railways and improvements in means of communication, the local bodies joined together to form national unions. In time unions for the semi-skilled and unskilled workers were formed, and now

workers in most trades and industries have their unions.

TRANSFORMER, an electrical apparatus for converting power from a high voltage to a low, or vice versa. It consists of two coils, the primary and secondary, wound round an iron core. See **CURRENT** and **INDUCTION COIL**.

TRANSJORDAN lies in the Near East and is ruled by a king. Most of the country is desert, except in the extreme west. The Palestine branch of the oil pipeline from Iraq passes through Transjordan. The capital of the country is Amman.

See the map of the **NEAR EAST**.

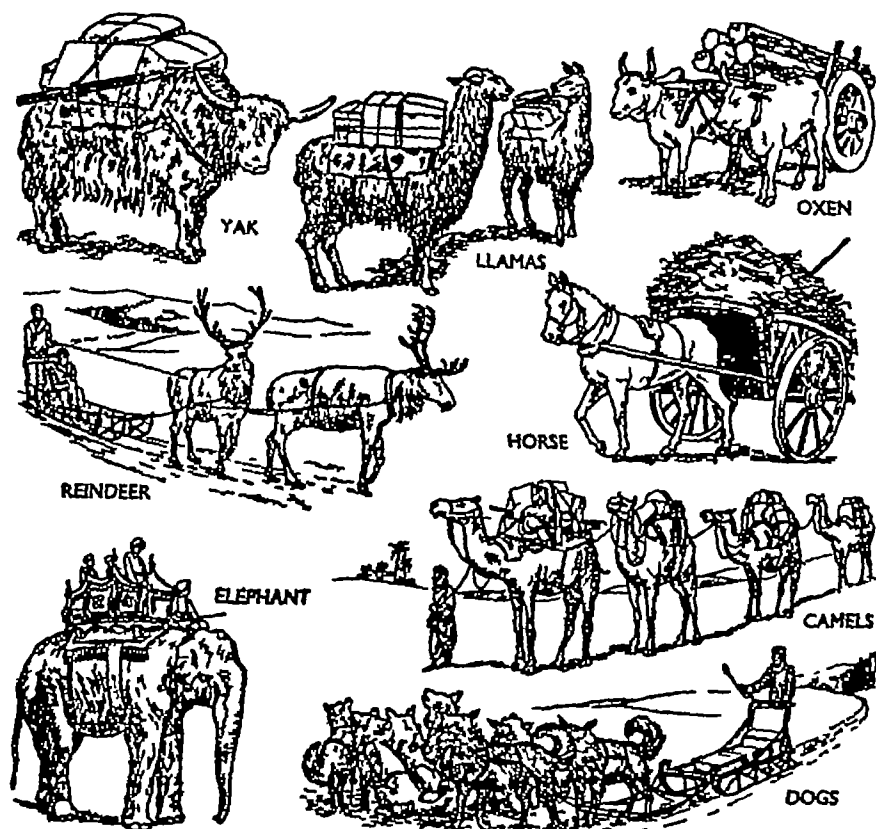
TRANSMUTATION OF ELEMENTS. The **ALCHEMISTS** believed that if they could only find the right chemical agent, they could turn one element into another, say lead into gold. This has been shown to be impossible, in the sense in which they meant it. But it has now been proved that changes of this kind can be produced by bombarding an element with electric charges. Radio-active elements also are in a state of continuous change from one element to another.

See **RADIO-ACTIVITY**.

TRANSPIRATION is the process by which plants get rid of surplus water in the form of water vapour through their **STOMATA**. Transpiration is active by day in summer, but slows down at night, and during winter it stops in **DECIDUOUS TREES**.

TRANSPLANTING. See **THINNING OUT**.

TRANSPORT. In primitive times, women acted as pack-carriers since the men, who were the hunters, had to be free of anything that would hamper rapid movement. Later, animals were used, and the ass, dog, elephant, yak, horse,



Beasts of burden still used as transport in certain parts of the world

camel, llama, mule, ox and reindeer became beasts of burden, often harnessed to vehicles. They are still so used in various parts of the world today.

Where there are rivers, water transport began early after crude coracles and canoes came rafts with sails, and later vessels propelled by oars as well. When man took to the sea, he built ships which became larger and larger as time went on, with wider and wider spreads of sail, thus enabling goods and people to be taken all over the world. At the beginning of the 19th century, the steam engine was used to propel ships, first by driving a paddle at the side, then propellers at the stern. Today many fast ships use the turbine

or the motor as a means of driving the propeller.

In Britain, the first roads were built by the Romans for moving their armies about, but after they left the roads fell into neglect and the only comfortable means of travel was by horse. Then when the stage coach became the means of public transport, good roads were necessary, and much road-building was undertaken, especially during the 18th century. With the invention of the steam locomotive by Stephenson, travel by railway became the most popular means of transport. Today we have express passenger trains, milk trains, fish trains, goods trains and many others, all controlled by up-to-date signalling methods.

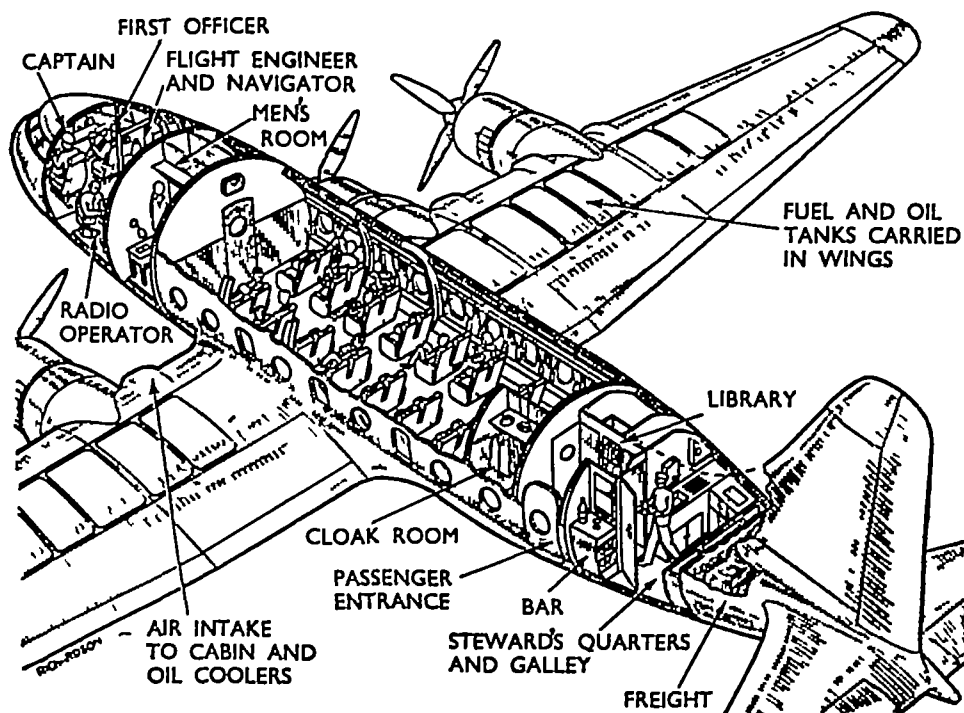
The invention of the internal combustion ENGINE made possible the motor car and omnibus for carrying passengers and vans and lorries for the transport of goods. Development in the use of electricity has provided us with the tram-car and trolleybus, and the electric train, which is especially useful for railways running in tunnels underneath big congested cities such railways exist in London, Paris, New York, Moscow and elsewhere.

In man's conquest of the air the BALLOON of the 18th century and the airship of the late 19th century have been superseded by the AEROPLANE. It is less than half a century since the WRIGHT brothers were experimenting with their machine. Today the chief cities of the world are linked by a network of air routes, over which fly huge planes carrying freight and passengers in conditions of ever-increasing comfort and safety.

TRAPEZIUM. See MENSURATION

TREASON, is a crime committed against the supreme authority of the State or its head, and is considered the most serious crime which can be perpetrated. The law of treason existing in Great Britain today is based on that passed during the reign of Edward III, which classes amongst acts of treason—compassing or imagining the king's death; levying war against the king of the realm, adhering to his enemies in his realm, and giving them aid and comfort anywhere.

The punishment of treason in the past was very barbarous. A convicted man was drawn on a hurdle to the place of execution and there he was hanged, and while still alive drawn and quartered. In the case of a woman, she was burned. In 1790 the punishment was changed to hanging till dead for women, and in 1814 the same for men.



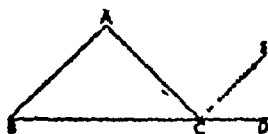
Inside a passenger plane, the most modern form of transport

During the Second World War a new word was coined for a person who co-operated with the enemies of a country, gave them aid and acted against the constitution of the country. Such a person was termed a "Quisling" and the word was derived from the fact that the first person actively to co-operate with the enemy in this way was a Norwegian named Quisling.

TREE and **SHRUB**, **PERENNIAL** plants which do not die, like herbaceous perennials, in winter. A shrub has many stems, a tree one main stem or trunk. The trunk is covered with tough, protective bark, its colour, thickness and irregularities being characteristic of each species of tree. Roots extend outwards so that those farthest from the trunk base receive water dripping from the outermost leaves. Many trees grow throughout their life, which may extend over several centuries. The type of woodland tree depends on the soil. Oaks like clay soil, birches are often found on sandy soil and beech where lime is present. See **CONIFERS**, **DECIDUOUS TREES**, **WOOD**.

TRIANGLE. A triangle is the simplest straight-lined figure, hence its importance in **GEOMETRY** and **TRIGONOMETRY**.

The three angles of a triangle together equal two right angles. When we continue the side BC of



the triangle ABC to D , ACD is the *external angle* at C ; the external angle is equal to the sum of the interior and opposite angles. angle $ACD = \text{angle } A + \text{angle } B$. We prove these propositions by drawing CE parallel to BA . Then angle

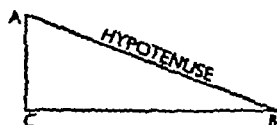
$ECD = \text{angle } B$, angle $ACE = \text{angle } A$, hence angle $ACE + \text{angle } ECD = \text{angle } A + B$ (see **PARALLELS**). Add angle ACB to both sides.

Angle $A + \text{angle } B + \text{angle } ACB = \text{angle } ACD + \text{angle } ACB = 2 \text{ right angles}$.

A triangle with all three angles acute (less than a right angle) is called an *acute-angled triangle*. An *obtuse-angled triangle* has one angle obtuse (greater than a right angle).

An *isosceles triangle* has two sides equal. An *equilateral triangle* has all three sides equal. A *scalene triangle* has all its sides unequal.

A *right-angled triangle* has one angle a right angle, so that the sum of the other two angles is a right angle. The side opposite the right angle is called the *hypotenuse*. The



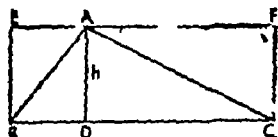
square on the hypotenuse is equal to the sum of the squares on the other two sides.

$$AB^2 = AC^2 + BC^2$$

This is Pythagoras' theorem.

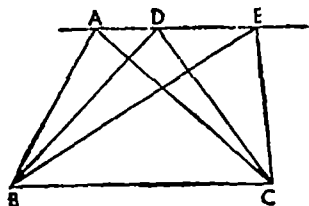
The area of a triangle is equal to $\frac{1}{2}$ base \times perpendicular height.

The triangle ABC has half the area of the oblong $BCFE$, on the



same base and with the same height. AD is the perpendicular to BC , giving h , the height, and dividing ABC into two triangles, ADB and ADC . Now ADB is half $EADB$ and ADC is half $FADC$. Therefore

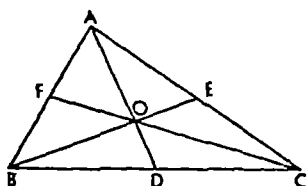
ABC is half $BCFE$ It follows from this that all triangles, such as ABC , DBC and EBC , on the same base,



BC , and between the same parallels, AE and BC , are equal to one another in area

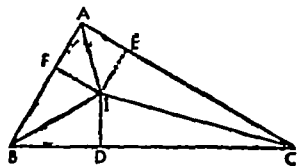
The following sets of lines in a triangle are concurrent (run together at a point)

(1) The medians, that is lines from the middle of a side to the



opposite apex The medians trisect each other, so that $AO = 2OD$, $BO = 2OE$, $CO = 2OF$

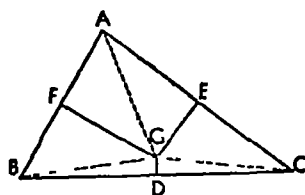
(2) The bisectors of the angles I , where the bisectors meet, is the centre of the *inscribed circle* (a circle which can be drawn inside



the triangle touching the three sides) Perpendiculars from I to the sides (ID , IE , IF) are equal, because they are all radii of such a circle

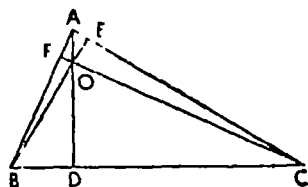
(3) Perpendiculars to the sides from their mid-points These meet at G Lines from G to A , B and C are equal So with G as centre we can draw a circle passing outside

the triangle through A , B and C ,



this is the *circumscribed circle* and GA , GB , GC will be radii

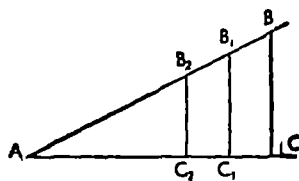
(4) Perpendiculars from the apexes to the opposite sides AD ,



CF and BE are the perpendiculars from the apexes and they meet at O

TRIGONOMETRY. Trigonometry deals chiefly with the relations of the sides and angles of **TRIANGLES.**

(1) BAC is an angle Take any point B in AB and draw the perpendicular BC to AC Wherever the point B is taken we always get



a triangle of the same shape, so long as we do not change angle A

The ratio $\frac{BC}{AB}$ is always the same

That is $\frac{\text{perpendicular}}{\text{hypotenuse}}$ is constant

This ratio is called the sine of the angle A We write "sin" for short

thus, $\sin A = \frac{BC}{AB} = \frac{\text{perpendicular}}{\text{hypotenuse}}$

$\frac{AC}{AB} = \frac{\text{base}}{\text{hypotenuse}}$ is called the cosine ("cos" for short)

$\frac{BC}{AC} = \frac{\text{perpendicular}}{\text{base}}$ is called the tangent of the angle ("tan" for short)

(2) We also use the reciprocals of these ratios

$\frac{1}{\sin A}$ is called the cosecant

("cosec") $\text{cosec } A = \frac{\text{hypotenuse}}{\text{perpendicular}}$

$\frac{1}{\cos A}$ is called the secant ("sec")

$\sec A = \frac{AB}{AC} = \frac{\text{hypotenuse}}{\text{base}}$

$\frac{1}{\tan A}$ is called the cotangent ("cot")

$\cot A = \frac{AC}{BC} = \frac{\text{base}}{\text{perpendicular}}$

(3) A great many relations can be established between the ratios

$$(i) \frac{\sin A}{\cos A} = \frac{BC}{AB} - \frac{AC}{AB} =$$

$$\frac{BC}{AB} \times \frac{AB}{AC} = \frac{BC}{AC} = \tan A$$

(ii) By Pythagoras' theorem $AB^2 = BC^2 + AC^2$ Divide both sides in turn by AB^2 , BC^2 , AC^2

$$1 = \frac{BC^2}{AB^2} + \frac{AC^2}{AB^2}$$

$$\text{or } 1 = \sin^2 A + \cos^2 A$$

($\sin^2 A$ means the square of $\sin A$, or $\sin A \times \sin A$)

$$\frac{AB^2}{BC^2} = 1 + \frac{AC^2}{BC^2}$$

$$\text{or cosec}^2 A = 1 + \cot^2 A$$

$$\frac{AB^2}{AC^2} = \frac{BC^2}{AC^2} + 1$$

$$\text{or sec}^2 A = 1 + \tan^2 A.$$

(4) One of the most important uses of trigonometry is the solution of triangles. There are three sides and three angles in a triangle if we are given three of these six items (including at least one side), we can calculate the others, with the aid of trigonometrical tables

TRINIDAD is the largest island of the Lesser Antilles of the WEST INDIES, it produces sugar, cocoa, coffee, timber, fruit and molasses, but is best known for its oilfields which lie in the south near the famous lake of pitch or asphalt. It has a fairly large Indian population, and most of the people are of mixed Indian and Negro descent. The capital is Port of Spain. See the map of SOUTH AMERICA, north of which Trinidad lies.

TRINITY, the Christian conception that the One God taught of by Jesus is in Three Persons—the Father, the Son (Jesus Christ), and the HOLY GHOST. The belief that God is a Trinity of Persons is traced back to the New Testament, and in the first few centuries of the Christian Church there was much controversy as to the exact meaning of the Trinity.

TRINITY HOUSE is a corporation which looks after the light-houses, buoys and beacons round the coasts of Britain. It also supervises the pilots who guide large vessels to and from the ports. The "Elder Brethren" who control Trinity House act as assessors in the Admiralty Division of the High Court, to hear shipping disputes.

TRIO, a musical work for three performers, also the middle section of certain dances and marches originally performed by three instruments.

TROCHEE See PROSODY

TROMBONE, a brass musical instrument in which the length of the tube is usually altered by a "slide." There are generally three trombones in the ORCHESTRA, forming, with the TUBA, a quartet of lower pitched brass instruments. Picture on page 405.

TROPICS, that part of the earth's surface between the Tropic of Cancer (latitude $23\frac{1}{2}$ deg N)

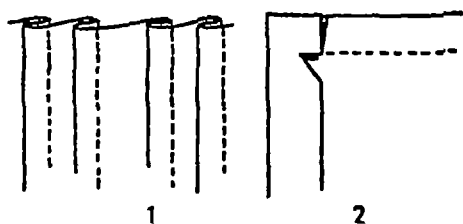
and Tropic of Capricorn (latitude $23\frac{1}{2}$ deg S) The sun is vertically overhead at noon about 21st June at the Tropic of Cancer and about 22nd December at the Tropic of Capricorn Within the tropics the length of daylight varies from $10\frac{1}{2}$ to $13\frac{1}{2}$ hours

TROUBADOUR, poet-musician of the Middle Ages in southern France Mostly of aristocratic birth, troubadours played an important part in upholding the traditions of chivalry In northern France they were called Trouvères In attendance on them were their servants (called in southern France, Jongleurs), possibly to play accompaniments to their masters' songs The German Minnesingers were akin to the Troubadours and were succeeded by the MASTERSINGERS The musical entertainers of those days who wandered from town to town were known as Minstrels

TRUMPET, the treble instrument of the brasses in the ORCHESTRA The sounds are produced by the player's lip-pressure, assisted by valves, which alter the length of the tube It is also used in dance bands, often muted, i.e. with a stopper inserted in the bell to alter the tone Picture on page 405

TUBA, a big brass musical instrument, which supplies the bass of the brass instruments in an ORCHESTRA or BAND It has valves, by means of which the vibrating air column can be altered, thus altering the PITCH of the note produced Picture on page 405

TUCKS in dressmaking are used decoratively and to take up fullness When cutting out, allow twice the width of each tuck in addition to the width of the article The placing of tucks needs care so that the arrangement is pleasing There should be a space between each



Arranging groups of tucks

tuck, and they look better if worked in groups with a larger space between each group (see 1) Tucks are tacked in position, then either run by hand or machined and fastened off securely a marker will assist to keep the tucks even and line of stitching straight (see 2)

TUNDRA, regions of semi-barren, marshy land near the ARCTIC circle frozen in winter, incapable of cultivation and sustaining little more than MOSS and REINDEER

TUNGSTEN is a metallic ELEMENT of very high melting point, used for the filaments of electric light bulbs and in certain hard steel alloys

TUNISIA, French North African protectorate ruled by a Bey under a French Resident-General The European population, concentrated mostly in the coastal settlements, is about half French and half Italian Olive oil, dates and phosphates are exported from Tunis, the capital See the map of AFRICA.

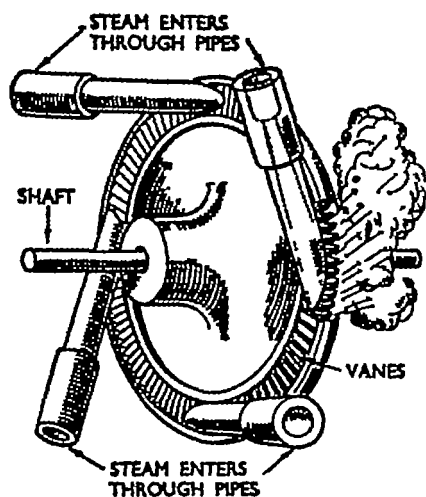
TURBINE, a type of engine where power is obtained from water, steam, or high pressure gas pressing against a series of vanes set round a shaft, thus turning the shaft rapidly See BOILER and HYDRO-ELECTRICITY

TURGENEV, Ivan (1818-1883) The Russian novel blossomed in the work of a group of great writers of whom Turgenev was the first to be translated Although himself a progressive thinker he depicts with satiric insight the educated young Russian with a passion for reform

His many stories and sketches show understanding of peasant life and a poetic feeling for the countryside. Among his novels are *Smoke*, *Fathers and Sons* and *Virgin Soil*.

TURKEY is a Near East republic including Asia Minor (Anatolia) and the south-eastern tip of Europe. The high **PLATEAUS** of the interior have a steppe-like **CLIMATE** but the coastal margins have more rain. Wheat, mohair, wool and skins are the chief products of the plateaus, and tobacco, olives, figs and silk are produced in the coastal areas. The development of railway communications is aiding the exploitation of mineral resources, such as copper and chromium ores. Ankara (Angora) is the capital and Izmir (Smyrna), the chief port. Turkey in Europe is that part of Turkey consisting of the region between the lower Maritza valley and Istanbul (Constantinople). It gives Turkey control of the entrance to the Black Sea through the Dardanelles and the Bosphorus. Istanbul is a port lying on the great rail route across Europe to Asia.

See maps of the **BALKAN PENINSULA** and of the **NEAR EAST**.



Principle of the steam turbine

History From the **CRUSADES** onwards the Mohammedan Turks were of great concern to Europe. They captured Constantinople in 1453 and by 1683 they had conquered their way to the gates of Vienna, after which they were gradually driven back, and the Balkan States freed. In 1922, the last of the sultans fled from Constantinople (Istanbul). A republic was set up, and Mustafa Kemal, since known as Kemal Ataturk, became President. He was the maker of modern Turkey, and introduced many reforms, including the Roman alphabet in place of the Arabic. A great drive in education resulted in a big increase in the number of Turks able to read.

TURNPIKE, a frame of pikes or a gate which was put across a road to stop carts and other vehicles passing until toll had been paid.

After the Romans left Britain, the roads of the country were neglected and allowed to get into a very bad state. No attempt was made to remedy the condition until the time of George IV, when the Turnpike Acts came into operation, by which the cost of repairing and remaking roads was to be met by the institution of tolls, and each parish was made responsible for maintaining its own roads. See **TRANSPORT**.

TURPENTINE is a liquid distilled from the resin of pine trees. It is a very good solvent and evaporates easily, and is therefore used as a thinner in **PAINT**.

TURTLE. See **TORTOISE** AND **TURTLE**.

TYPEWRITER, an office machine which prints documents and correspondence letter by letter. It has a keyboard, and when the appropriate key is depressed the required character comes into play, presses an inked ribbon on to the paper and leaves its impression.



UGANDA is a British PROTECTORATE in Africa on the equator, much of the country is highland, however, and the climate is not severe. Native-grown cotton is exported to India via Mombasa, and coffee is grown on European-owned plantations. The capital is Entebbe on Lake Victoria. See the map of AFRICA.

UKULELE See GUITAR.

ULTRA-VIOLET LIGHT is a type of radiation, very similar to the ordinary light given out by hot bodies. In passing through a prism it is bent more than the violet light of the SPECTRUM, hence its name. It affects photographic plates and also produces vitamin D in a human body which is exposed to sunlight or any artificial source of ultra-violet light. Such treatment is therefore useful for diseases, e.g. rickets, caused by a deficiency of vitamin D in the DIET. The mercury vapour lamp is a rich source of this radiation.

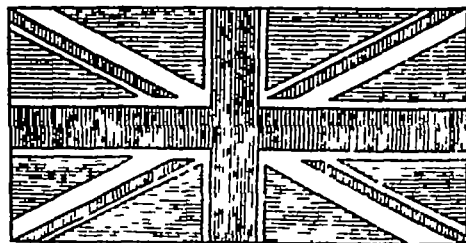
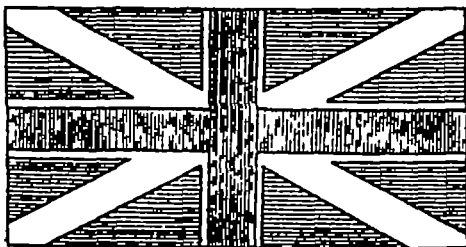
ULYSSES is the Latin name for ODYSSEUS.

UNION JACK, the name usually given to the national flag of Great Britain.

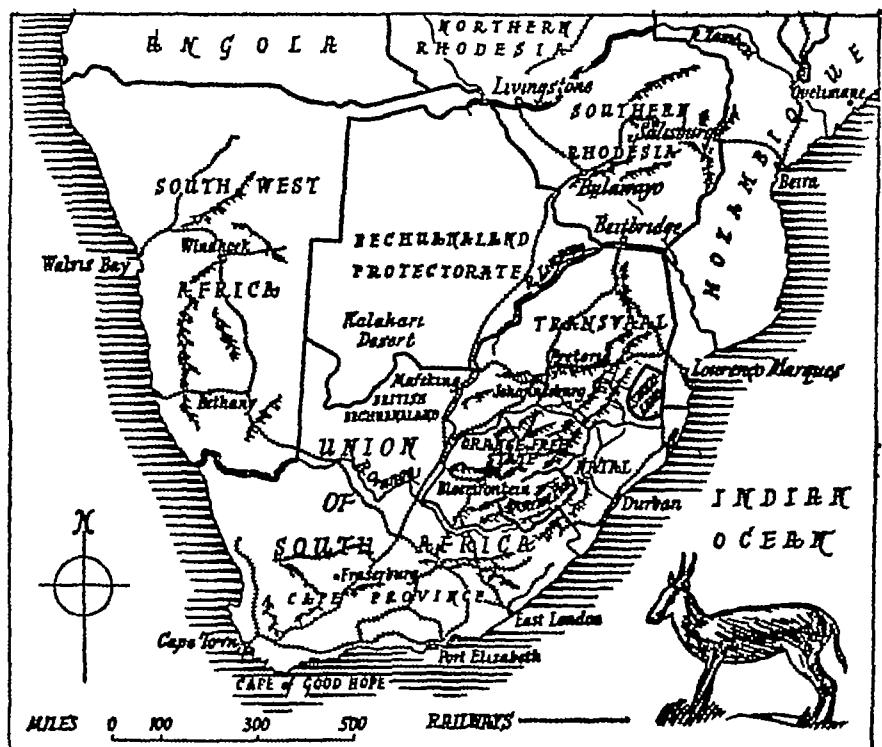
After the union of the crowns of England and Scotland in 1603, a new flag was ordered in which the English flag—St George's red cross on a white field (background)—was added to the Scottish flag—the white diagonal cross of St Andrew on a blue field. This flag was ordered to be flown at the maintop of all British ships except British men-of-war, which were to fly it from the jack-staff at the end of the bowsprit—hence the name Union Jack, though it is really a jack only when flying from the jack-staff.

In 1801, when the Irish Parliament was united with the Parliament of England and Scotland, the cross of St Patrick, patron saint of Ireland, was added to the other crosses. St Patrick's cross is a red diagonal cross on a white field. These three crosses make up the flag we know as the Union Jack.

UNION OF SOUTH AFRICA, a self-governing Dominion comprising the former British colonies of Natal and the Cape of Good Hope and the former Boer Republics of the Transvaal and Orange Free State. The south-west has a Mediterranean climate, and vineyards and orchards are common. Farther north on the dry tablelands, sheep, goats and ostriches are reared. Diamonds are mined around the River Orange and gold on the Rand. The High Veldt is an almost treeless grassland where sheep, cattle and goats are reared. Gold is the most important export, and fruit, wool, sugar, skins and diamonds are also exported. The chief



Development of the Union Jack



Map of the Union of South Africa, land of Briton and Boer

towns are Cape Town, the legislative capital and a coaling station on the Cape shipping route to the east, Pretoria in the Transvaal, the administrative capital, the port of Durban, the inland commercial and mining centre of Johannesburg, and Bloemfontein, the judicial capital. The Union contains the largest proportion of Europeans in Africa—of Dutch and British descent, it has also a fairly large Asiatic population besides a great native African population. English and Afrikaans are both official languages.

The Union of South Africa controls SOUTH-WEST AFRICA.

History The first Europeans to settle in South Africa were Dutch farmers (Boers) who arrived in the 17th century. During the Napoleonic Wars, the Cape was cap-

tured by the British (1814) and British emigrants landed (1820). The British and the Boers did not agree, and in 1836 the Boers made "The Great Trek"—they packed their families and household goods into their ox-wagons, drove their cattle before them, and with great heroism moved northward where they founded two Dutch republics, the Transvaal and the Orange Free State.

In 1886, gold was found in the Transvaal. Many Britishers and others flocked there, but the Boers did not want them, and their President, Paul Kruger, refused to give the Uitlanders (as they were called) any share in the government. In 1895, Dr Jameson headed an armed force in an unsuccessful, unofficial raid into the Transvaal, which caused bitter feeling. In

MILES 0 400 800 1200
RAILWAYS

ARCTIC OCEAN



Map of the Union of Soviet Socialist Republics, with names of the separate

1899 war broke out between Britain and the Boers. The Boers surrendered in 1902 and Kruger died in 1904 in exile in Switzerland. The Boer provinces were given self-government in 1906, and in 1910 the Union of South Africa—a self-governing Dominion, comprising British and Boer colonies

—was formed, the first premier being Louis Botha, a former Boer general.

One of the makers of South Africa was Cecil Rhodes. He went to the Cape, and made a fortune in diamonds. He founded the British South Africa Company which held the territory now known as



self-governing republics in the Union

Rhodesia He was Premier of Cape Colony in 1890, and was interested in planning an all-British route from the Cape to Cairo He died in 1902, and left much of his wealth to provide scholarships for young colonial, American and other students at Oxford University.

Field-Marshal Smuts, a famous

Boer general, became Premier of the Union of South Africa, and was a strong and invaluable supporter of Britain and the Allies through two World Wars, he is undoubtedly one of the greatest statesmen of the modern world

UNION OF SOVIET SOCIALIST REPUBLICS (The Soviet Union or Russia), together the largest country in the world, covering about a sixth of the world's land surface, and extending half-way across Europe and right across Asia The Trans-Siberian Railway links Vladivostok on the Pacific with Leningrad on the Baltic European Russia is entirely lowland, except for the Caucasus Mountains and the Urals, which separate it from Siberia In the far east the plains of Siberia are bordered by highlands, and in the south by high mountains The whole northern coastline is inside the ARCTIC circle, and borders a region of TUNDRA The country is drained by several long rivers, the largest of which are the Lena, the Yenisei (one of the longest in the world), and the Ob, draining into the Arctic, the Volga (into the Caspian), and the Don and Dneiper (into the Black Sea) The northern tundra regions are inhabited by NOMAD Mongol tribes depending mainly on reindeer for food and other necessities The severe climate has limited development in the past, but oil, salt and mineral ores are being sought for The coniferous forests farther south are more highly developed, and timber and furs are produced On the Siberian plains wheat, oats and rye are grown and cattle and sheep are reared Most of the older Siberian towns grew up around the Trans-Siberian Railway, such as Chelyabinsk, Sverdlovsk, Omsk, Tomsk, Irkutsk near Lake Baikal and the

Pacific port of Vladivostok In the south large areas of Turkestan are desert, but several rich oases occur in the valleys among the foothills Tashkent, Samarkand and Merv are ancient oasis towns and caravan centres, where cotton, fruit and tobacco are grown In the semi-desert areas nomadic Kirghiz raise horses, cattle, sheep and goats Coal and other minerals are widespread, and industry has been developed

European Russia has vegetation belts similar to those of Asiatic Russia, in the north are the frozen and tundra-covered regions, with the port of Archangel on the White Sea and the ice-free port of Murmansk on the Arctic as the chief towns, and in the south the rich grain-growing Black Earth region of the Ukraine, Georgia, the Black Sea coast and Crimea, with its Mediterranean climate, where fruit, wine and cereals are produced The Caucasus Mountains contain one of the richest oilfields in the world, around Baku and Grozny Chief ports on the Black Sea are Odessa and Sevastopol Mineral wealth is very great, and around the coalfields in the Don basin a great manufacturing region has grown up Stalingrad, Kiev, Kharkov and Rostov are important towns in this area Iron and coal are also found in the Urals, where the new town of Magnitogorsk is the centre of an important manufacturing area In the great STEPPES of central Russia, cereals, mainly wheat, sugar beet and other crops, are grown on collective farms Moscow, the capital of the Union, is an industrial centre Leningrad to the north, the old capital, specializes in heavy industry and shipbuilding, as a port it is ice-free only in summer

Industry and agriculture are controlled by the Government

See SOVIET Although a large number of the people still work on the land, the output of many important industries has been multiplied several times over under the successive Five Year Plans initiated since the Russian Revolution

The Union is composed of sixteen republics, the largest, Russia, having self-governing areas The names of the republics are given on the map

History About King Alfred's time, the Vikings crossed to Russia, as they did to England, and helped to unite the Slavs into the Russian nation In the later Middle Ages, Russia suffered long from the TARTAR invasion from Asia Then for centuries Russia was under the rule of despotic Tsars The peasants were poor and ignorant, and the FEUDAL SYSTEM survived in Russia into the 19th century.

Towards the close of the 19th century a revolutionary movement, known as Nihilism, was increasing It aimed at an extreme reconstruction of society, and there was a continuous struggle between the revolutionaries and the police

In 1896, Russia secured Port Arthur in China, and connected it with St Petersburg (now Leningrad) and Moscow by railway In the war with Japan (1904-1905), the Japanese severely damaged the Russian fleet, while on land the Russians lost 400,000 men Port Arthur and the local stretch of railway were handed over to Japan This defeat caused discontent

In 1917, towards the close of the First World War—in which the Russians suffered severely—the great Bolshevik Revolution took place Tsardom was destroyed, Soviets (or Councils) were organized and later was formed the Union of Soviet Socialist Republics (U S S R), a vast Union of Slav

and Asiatic peoples extending from Central Europe to the Pacific. The man who carried out these changes was LENIN, he was succeeded by STALIN, who organized the remarkable Five Year Plans to create new industries and increase production, and generally improve the welfare of the two hundred million people.

At the beginning of the Second World War, after Germany had attacked Poland, Russia invaded and occupied half the country to prevent Germany from gaining the whole. She also invaded Finland, whose shores were very close to Leningrad, Estonia, Latvia and Lithuania (which were Baltic states created after the First World War) were joined to the Soviet Union in 1940. When the Germans invaded Russia (1941), the British and Allied Governments sent convoys of munitions and supplies to Russia via Archangel and the Persian Gulf, and in 1942 Great Britain and the U S S R signed a treaty of alliance. The Germans penetrated near to Moscow and Leningrad, and reached the Urals, but they were eventually thrust back.

UNIT. In measuring any quantity, we compare it with a convenient standard amount of the quantity, such an amount is called a unit. The unit of length is the yard, divided into 3 feet or 36 inches. The unit of weight is the pound, the weight of a standard mass of metal. The unit of time is the second, which is $\frac{1}{86400}$ of a day (of 24 hours).

Other units are derived from these three fundamental units. The unit of area is the square inch, of volume, the cubic inch, of speed, a foot per second or a mile per hour,



The Kremlin at Moscow, seat of the Government

of density, a pound per cubic foot. Examples of other units are British unit of heat = amount of heat required to raise one pound of water through 1 deg F. Unit of force (the poundal) = force required to give a mass of one pound an acceleration of 1 foot per second, per second. See also METRIC SYSTEM, WEIGHTS AND MEASURES.

UNITED KINGDOM, consists of GREAT BRITAIN and NORTHERN IRELAND.

UNITED NATIONS ORGANIZATION (also called United Nations, UN or UNO), an association of allied nations whose aim, by means of frank discussion and co-operation, is to maintain peace and prosperity between the nations. Its Charter was signed by representatives of fifty-one nations in conference at San Francisco in June, 1945. Among its important commitments is UNESCO—United Nations Educational, Scientific and Cultural Organization. UNO held its first meeting in London in January, 1946, and its second meeting in March, 1946, in New York. Its present home is Lake Success. UNO is a kind of World Parliament, and its success will depend mainly on friendly and close co-operation and goodwill between the three Great Powers—

USA, USSR, and the British Commonwealth

UNITED STATES OF AMERICA, a FEDERAL Republic of 48 states and the federal territory of the District of Columbia, which contains Washington, the capital. The west consists largely of the plateaus and peaks of the Rocky Mountains. Cattle are reared on the plateaus and gold, silver, lead and copper are mined in the western mountains. The fertile coastal strip of California produces grapes, peaches and other fruits. The largest towns in this area are Los Angeles, oil-producing and film centre, and the port of San Francisco with its magnificent Golden Gate Harbour. On the central plains, stretching south from the Great Lakes and drained by the great Ohio-Missouri-Mississippi river systems, wheat and maize are grown in the north and cotton in the south, and cattle and pigs are raised. The sub-tropical lands on the Gulf of Mexico produce rice, sugar, pineapples and oranges. The chief towns are New Orleans on the Mississippi delta and Miami in Florida. Tobacco is grown on the slopes of the eastern Appalachian Mountains, especially in North and South Carolina, Kentucky and Virginia. Along the edges of this range, coal and oil are found, and heavy industry is mostly concentrated around the coalfields, especially in Pennsylvania. The main oil-producing centres are in California and Texas. The steel towns of Pittsburgh, and Detroit and Cleveland on Lake Erie, are centres of the northern manufacturing region. Manufactures in the south are backward, and consist mainly of textiles, except in the iron and steel area in Alabama. New England, which consists of the States of Maine,



Map of United States of America,

New Hampshire, Vermont, Massachusetts, Connecticut and Rhode Island, has a temperate climate and grows vegetables and temperate fruits on small farms. The north-eastern coast has important fisheries. New York, lying on an island in the Hudson River, is one of the largest cities in the world and a terminus for transcontinental air, road and rail routes. Chicago on Lake Michigan is an important rail junction and commercial centre.

The population consists of descendants of the early colonists and descendants of later immigrants.



showing the separate states and most important towns, cities and railways

mainly from Europe. The original American-Indian inhabitants have survived mostly in the west, and although reservations are now provided by the Government where they may live in their ancestral manner, the pure Indians are gradually dying out (See RACES). About a tenth of the people are Negroes descended from African slaves imported to work the southern cotton plantations. Most of them still live in the South, and in some areas form the bulk of the population. There is a fairly large Mexican population in the south-

west areas won by conquest from Mexico, and a French-speaking colony in the former French territory of Louisiana.

The United States have tremendous natural resources, and are practically self-supporting and one of the greatest industrial and commercial powers in the world.

History The United States, once the thirteen British Colonies on the North American seaboard, became an independent nation in 1783, after their war of INDEPENDENCE. For more than a century they followed the advice of their great

leader, George WASHINGTON, and kept out of European politics. Gradually the States increased in number and power by spreading westwards, and developing great industries.

In 1823 certain European powers seemed inclined to interfere (on behalf of Spain) with the Spanish colonies in South America, who were then fighting for their freedom under Bolivar, the Liberator. It was then that James Monroe, President of the U S A, issued his famous Monroe "Doctrine" that "the American continents are henceforth not to be considered as subjects for future colonization by any European Powers," and if the latter interfered in North or South America they would incur the hostility of the U S A.

Between 1861 and 1865 the United States were engaged in a great Civil War. The cause of the conflict was divided opinions on the question of SLAVERY in the U S A. The Northern States wished to end slavery, the Southern States wanted to keep their slaves—even if they seceded from the Union and broke up the unity of the States. The North won, the Union was maintained and the slaves were freed. The President at this difficult time was Abraham LINCOLN. By 1869 the States had spread to the Pacific.

During the FIRST WORLD WAR the U S A declared war on Germany in 1917, when they played an important part for the first time in a European conflict.

When the SECOND WORLD WAR broke out (1939), the U S did not at first take a fighting part, though they helped Britain in various ways in her greatest hour of need. But when Japan attacked their naval base at Pearl Harbour in the Pacific in December, 1941, and also attacked

British possessions, the U S A declared war on Japan, Germany and Italy, and became a powerful addition to the United Nations, not only with their great military, naval and air forces, but by providing vast supplies of weapons, armoured cars, planes, food and other war necessities. Their great President, F D ROOSEVELT, had several meetings with British and Soviet statesmen. In his message to Congress he declared that the nations must seek the four freedoms—freedom of speech, freedom of worship, freedom from want, and freedom from fear.

UNITED STATES OF INDONESIA. See EAST INDIES.

URANIUM is a RADIO-ACTIVE metallic ELEMENT. As it is possible to split the uranium atom, uranium is used as the "explosive" in the ATOM BOMB.

URUGUAY, a South American republic, is a pastoral country with a temperate climate. Large herds of sheep and cattle are reared, and their products form the wealth of the country. The capital and chief port is Montevideo. See map of SOUTH AMERICA.

U.S.A. See UNITED STATES OF AMERICA.

U.S.S.R. See UNION OF SOVIET SOCIALIST REPUBLICS.

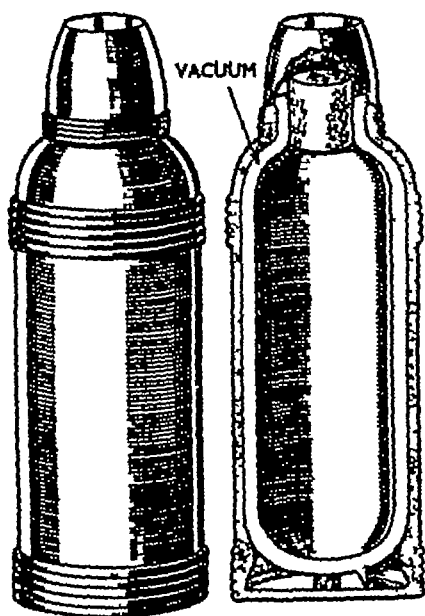
UTOPIA is the imaginary island of Sir Thomas More's romance of that name (written in 1516) where the inhabitants were perfectly happy and lived in communal comfort. By his description of this imaginary state More is really criticizing many of the medieval beliefs, customs and laws in the England of his time.

Today the word Utopia is applied to any imaginary state where things are perfect and is often applied satirically to contemplated social conditions which are considered to be impracticable.



VACCINATION. See INOCULATION

VACUUM FLASK, a container with double walls from between which the air has been withdrawn



Outside and inside the vacuum flask

The vacuum thus created is a poor conductor of heat. Furthermore, the walls of the container are silvered, since a bright surface absorbs less heat than a dull one. A vacuum flask is useful for storing hot liquids, as the heat does not escape easily and the liquid remains hot. Similarly, cold liquids do not obtain heat and so remain cold.

VACUUM PUMP, a pump used to extract gas from a vessel so that the pressure of the gas remaining falls to a low level. Some vacuum pumps work in a manner similar to a reciprocating steam ENGINE with a close fitting piston and light valves, others sweep the gas away

with a rotating vane inside a cylinder. For very low pressures the gas is sucked out by a rapid stream of mercury or oil vapour. Vacuum pumps are for vacuum DISTILLATION, and for other purposes such as withdrawing the air from wireless valves, vacuum flasks, and electric light bulbs.

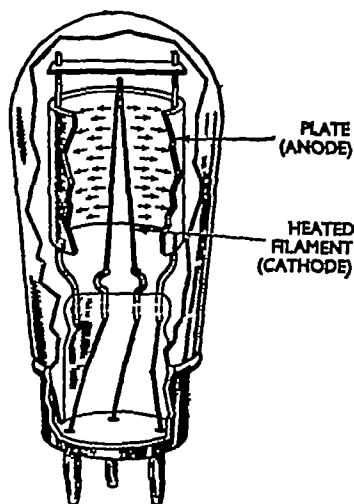
VALHALLA is in Norse MYTHOLOGY the palace to which the souls of slain heroes went after death where they were to live for ever feasting.

VALLEY, a depression between hills or mountains generally cut by a RIVER or GLACIER. The slope of the valley becomes gentler towards the mouth and the width of the valley increases. Dry valleys may be merely folds in the earth's surface but they often show evidence of river EROSION. The lack of water may be due to the porosity of the underlying rock in chalk and limestone areas. In other cases the river may have been diverted. A rift valley has steep sides as the result of the sinking of a strip of land.

VALVE In engineering a valve is a movable piece which stops or allows the passage of a fluid as desired. Good examples are the SAFETY VALVE on a boiler, which allows steam to escape when the pressure gets too great, the slide valve on a steam ENGINE, which controls the flow of steam to each end of the cylinder, the inlet and exhaust valves on a petrol MOTOR, which admit explosive gases into the cylinder and allow the burnt gases to escape, the throttle valve of a GOVERNOR.

A *thermionic valve* is used for rectifying (turning in one direction) alternating electric currents and

voltages There are many types of this valve, e.g. in WIRELESS transmission a valve of this sort is used for generating continuous waves In receiving sets a variation of the valve detects and rectifies alternating impulses received by the aerial



Thermionic valve rectifies current

—the heated filament, the cathode, sends across a stream of electrons to the anode each time the anode is positively charged from the aerial, and as these electrons can flow only from the cathode to the anode, and not back again, it means that alternating impulses on the anode cause a direct one-way surge of electrons, i.e. an alternating current becomes a direct one. A third form of the valve amplifies incoming signals.

VARNISH There are three types of varnish

(1) The old oil varnish used by coach builders, made from linseed oil boiled with copal or other hard gums, and turpentine

(2) Spirit varnishes based on a solution of shellac in METHYLATED SPIRITS. These are quick drying

(3) Synthetic varnishes, some a solution of cellulose nitrate, and some of hard manufactured resins in various solvents.

The object of a varnish is to give an attractive protecting surface to wood and other material, and at the same time form a surface which can be easily cleaned

VATICAN STATE, a tiny independent state comprising the Holy See of the Roman Catholic Church and ruled by the POPE. It consists of a part of Rome containing St Peter's Church and the residence and offices of the Pope

VAUGHAN WILLIAMS, Ralph (born 1872), an English composer who, building his art on folk-song and on the traditions of the Elizabethan composers, has by his symphonies, his operas and many works in other forms, achieved a position of great eminence

VEGETABLES. For growing vegetables, see ALLOTMENT GARDENING, LEAF CROPS, ROOT CROPS, ROTATION OF CROPS

To cook vegetables, remove coarse stalks and all discoloured or decayed parts. Place green vegetables after cleaning in salted water (1 tablespoonful salt to 1 quart of water), and leave for 1 hour, then rinse in cold water. Root vegetables are washed in cold water. *Cooking* Green vegetables, except spinach, are cooked with the lid off the saucepan, and in boiling water containing salt (1 dessertspoonful salt to 1 quart of water), and are cooked quickly to ensure their being tender. Too much cooking destroys the mineral salts, and so does the addition of soda. Root vegetables are put into cold salted water and cooked in a covered pan. Use only enough water to cover the vegetables. The water in which vegetables have been boiled can be used afterwards for stock. Spinach needs only the water which clings to it after washing. It should be washed very carefully. There should be no water with vegetables when they are

served, and they should be well strained and chopped if desired, but not mashed

A small knob of butter may be added before serving

VENEZUELA lies on the Caribbean Sea and the Atlantic The west coast is mainly mountain, the rest of the country, apart from plains north of the Orinoco, is mostly forest and swamp with an unhealthy climate Coffee and cocoa are produced and gold is mined, but the main wealth is oil The chief towns are Caracas, the capital, in the coastal highlands, and the port of Maracaibo See the map of **SOUTH AMERICA**

VENTRILLOQUISM is the art of using the voice in such a way that the sound seems to come from some source other than the actual

speaker The speaker, while forming words in the ordinary way, manages to avoid moving his lips, and if he has a puppet on his knee, whose mouth he can manipulate while he himself is speaking without



*Ventriloquist's
puppet*

moving his own lips, the audience has the impression that the words are coming from the puppet's mouth

VENUS (Greek Aphrodite) is in **CLASSICAL MYTHOLOGY** the goddess of love and beauty

VERB. See **GRAMMAR**

VERTEBRATE, any animal with a spinal column of bone or cartilage protecting the nerve-cord Each bone of the column is a vertebra **MAMMALS** are the class of vertebrates highest in **EVOLUTION**, then come in

order the **BIRDS**, **REPTILES**, **AMPHIBIA** and **FISH**

VESTA is in **CLASSICAL MYTHOLOGY** the Roman goddess and guardian of hearth and home In her temple at Rome a constant fire was kept burning by priestesses called **Vestals**

VIBRATION. All sounds are conveyed to our ears by vibrations of air (See **SOUND**) In stringed instruments, the string is set in motion by a bow or by being plucked by the finger or a quill In wind instruments the column of air is set in motion by means of the player's lips, or by a reed, or in other ways. The vibrations thus set up travel to our ears, and we hear the sound The **PITCH** depends on the number of vibrations a second Middle C on the piano is produced by 258 vibrations per second and the C above that by 516 By doubling the number of vibrations, an **OCTAVE** higher is produced, by halving, an octave lower The tuning-fork when vibrated produces a note of definite pitch, from which other notes can be gauged

VICTORIA (reigned 1837-1901) was the daughter of the Duke of Kent, fourth son of George III She succeeded her uncle, William IV, when she was eighteen years of age She married her cousin, Prince Albert of Saxe-Coburg

At the time of her accession, Lord Melbourne was Prime Minister, and he was of great help to the young queen The early years of her reign were marked by the agitation against the Corn Laws which forbade the import of foreign wheat until English wheat reached a high price This made bread dear In 1846, Sir Robert Peel, the Prime Minister, repealed the Corn Laws Another great statesman was Lord Palmerston, who for the first time brought Britain

and France into more friendly relations The CRIMEAN WAR and the INDIAN MUTINY were events of that period

The second part of the reign, after the death of Prince Albert (1861) and of Lord Palmerston (1865), was more concerned with colonial affairs, the Irish question, and parliamentary reforms The chief ministers of this period were DISRAELI, GLADSTONE, and Lord Salisbury Half the SUEZ CANAL shares

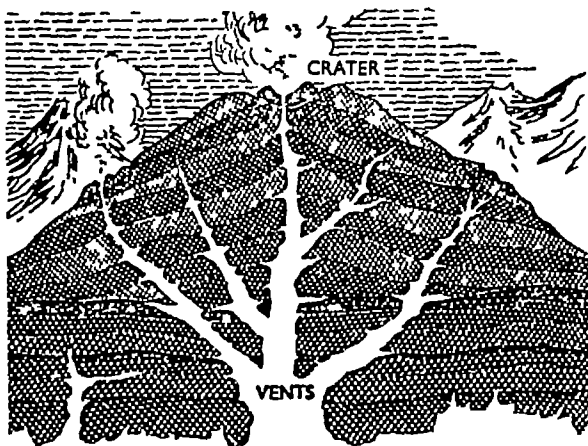
were purchased for Britain by Disraeli in 1875, and Victoria was proclaimed Empress of India in 1876

The Jubilee of 1887, and ten years later the Diamond Jubilee, were opportunities for the nation and empire to express their love and loyalty to one of the greatest of British sovereigns

VIOL, the name of a family of stringed instruments, rather like the VIOLIN family in general appearance, but with six strings, a fretted finger-board and a flat back Viols were very popular in Elizabeth's time (see MADRIGAL) before being superseded by the violin family The DOUBLE BASS retains several features of the viol

VIOLA, the alto VIOLIN Picture on page 404

VIOLIN, a musical instrument consisting of four strings tuned a fifth apart (see INTERVAL) stretched along a sounding box, and vibrated by means of a bow The instrument is held by the chin and left hand, the fingers of which press the various strings on to the finger-board and so alter the length of string free to vibrate, thus changing the PITCH of the note produced by the bow as it is drawn across the



Volcano formed of materials ejected through a weak point in the earth's crust

string by the right hand The other members of the violin family are the viola, violoncello, and double bass The violoncello is held between the knees, the double bass player has to stand in order to play his large instrument Pictures on page 404

VIOLONCELLO, the bass VIOLIN (the DOUBLE BASS being the deepest toned instrument of this group) Picture on page 404

VIRGIL (70-19 B C), Latin author of the *Aeneid*, an epic poem about the wanderings of AENEAS from Troy to Italy and the founding of the Roman State It includes the tragic story of the love of Dido, Queen of Carthage, for the hero Aeneas

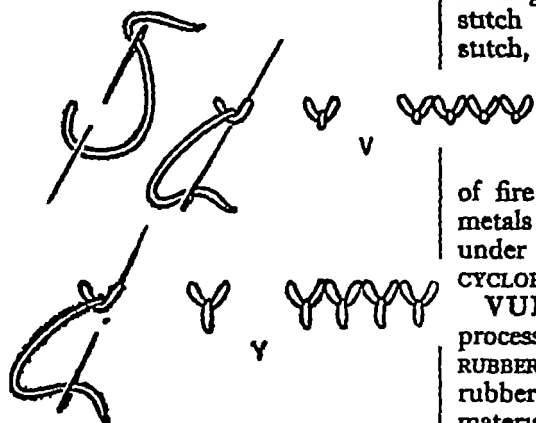
VISCOSITY is the property of certain liquids which causes them to flow in a dragging treacly way

VITAMINS are a group of important substances present in small amounts in certain foods Minute quantities of each are essential to health Vitamins A, B, C, D, and others have been isolated, their chemical make-up, and the effects due to the lack of each, discovered A and D are present in milk, butter, and fish-liver oils A promotes healthy growth, pre-

vents infection of the skin and night-blindness D, which can also be obtained from sunlight, causes bones and teeth to grow healthy, in its absence rickets occur B₁ and B₂, found in egg-yolk, yeast, and whole-meal bread, help to keep the nervous and digestive systems healthy C, present in fresh fruit and vegetables, prevents scurvy, which used to make men on a long voyage, far from fresh food, very ill See DIET

VITRIOLS are the sulphates of copper, iron and zinc, named blue, green and white vitriol respectively, because of the glassy nature of their crystals (Latin for glass is *vitrum*)

VOLCANO, a conical mass of materials long ago ejected from the earth through a point of weakness in the earth's crust, and now forming a mountain with a circular depression at the summit, called a crater If the volcano is active, as in Mount Etna in Sicily, materials such as molten rock or lava, volcanic ash, steam and other gases will be erupted through the crater from time to time The hot materials often force channels or vents through the side of the mound as well Volcanoes, active and extinct, are mostly to be found dotted



Making V and Y stitches

along the coasts of those countries washed by the Pacific Ocean

VOLE See RAT

VOLT. See ELECTRICAL ENERGY UNITS

VOLTAIRE, François Marie Arouet de (1694-1778), a pre-revolutionary French writer and thinker whose satire was directed against superstition and the clergy *Candide* and *Zadig* are his best known writings With ROUSSEAU he helped to focus the Frenchman's mind on the need for radical changes in his society

VOLTAMETER, a cell which measures the amount of electricity passing through a CIRCUIT by means of the electrolytic effect of the CURRENT See ELECTROLYSIS

VOLTMETER, an instrument for measuring in volts the pressure of an electric current It is often an AMMETER of high resistance

VOLUME is the amount of space occupied by any material We measure small volumes in cubic inches (the volume of a cube with 1-inch edges) Larger masses are measured in cubic feet or cubic yards, and very large masses in cubic miles See MENSURATION

V or Y STITCH is sometimes known as Fly Stitch The method of making V stitch is shown, and Y stitch simply requires a longer stitch, when catching down the loop

VULCAN (Greek Hephaistos) is in CLASSICAL MYTHOLOGY the god of fire and the art of working in metals His workshop was situated under Mount Etna in Sicily The CYCLOPS were his workmen

VULCANIZATION is the process of mixing SULPHUR with RUBBER and applying heat the crude rubber becomes a durable, elastic material similar to that which we normally use



WAGES are earnings for work done There are two main methods of payment (1) piece rate, (2) time rate

Piece rate is payment on the basis of output Time rate is payment on the number of hours worked Today wage rates are increasingly becoming a bargain between a **TRADE UNION** acting on behalf of the employees in a certain industry and the employers' association acting for all the employers whose workpeople are concerned

WAGNER, Richard (1813-1883), was a great German operatic composer who strove in his operas to get a perfect fusion of all the arts, acting, music, scenery, and so on His early works were *The Flying Dutchman*, *Tannhauser* and *Lohengrin*, for which, as for all his operas, he wrote his own **LIBRETTO** His later works, in which he tried to express his ideals and build "the art-work of the future," were based on German folk-lore—*The Ring of the Nibelungs*, consisting of four operas *Rhinegold*, *The Valkyrie*, *Siegfried* and *The Twilight of the Gods* His other works include the tragedy *Tristan and Isolde*, the comedy *The Mastersingers of Nuremberg* and the quasi-religious drama *Parsifal* He made great use of the **LEITMOTIV**

WALES is a mainly mountainous region, with lowlands in the south on the Severn estuary and the Bristol Channel, it includes the Isle of Anglesey off the north-west coast Industry is concentrated mostly in the south, in the coalfields and tinplate areas and the port of Cardiff For administration Wales is joined to England Many of the people, especially the small farmers

in the mountain areas, are of Celtic stock and some speak their original Celtic language

See maps of the **BRITISH ISLES** and **ENGLAND**

WALES, PRINCE OF. See **PRINCE OF WALES**

WALLABY. See **POUCHED MAMMALS**

WALLACE, William (1274-1305), Scottish patriot, was the son of a knight He resolved to free Scotland from the rule of **EDWARD I**, who had conquered the greater part of Scotland He gathered an army and while besieging Dundee, heard news of the advance of an English army towards Stirling Wallace immediately went to meet the enemy and won the great victory of Stirling Bridge (1297), driving the English army over the border

Wallace proclaimed himself Guardian of Scotland on behalf of King John (Balliol) whom Edward I held prisoner Then Edward himself marched into Scotland and defeated the Scottish forces at Falkirk (1298) Wallace escaped but was betrayed into the hands of the English, brought to London, tried, and executed in 1305

WALRUS. See **SEAL**

WALTON, Izaak (1593-1683), was a London ironmonger who was also the friend of poets, a man of letters himself and an inveterate angler He wrote biographies of, among others, John Donne and George Herbert, the poets His *Compleat Angler*, a dialogue between a fisherman and a huntsman, is a treasury of fisherman's joys and country pleasures

WAREHOUSE, a building where goods are stored A manufacturer has a warehouse to store

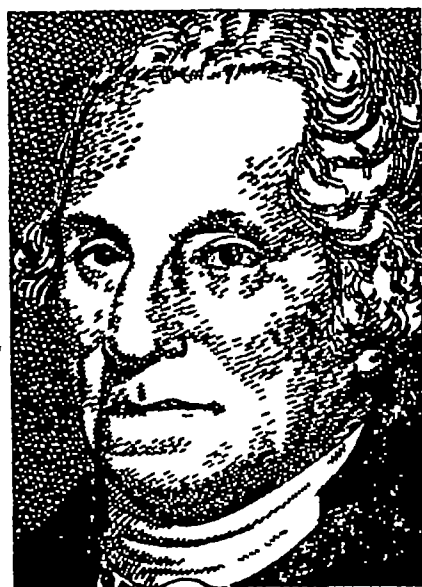
his raw materials or finished goods A wholesaler has a warehouse in which to store the goods he has bought from the manufacturer An importer has a warehouse in which to store goods that he has imported from abroad

If imported goods are subject to duty, as for example, tobacco and wine, they will be stored in a bonded warehouse under government supervision When these goods are removed for sale in the home market, duty is paid on them to the government, but if they are removed for sale abroad no duty is paid

WARS OF THE ROSES. See ROSES (WARS OF THE)

WART-HOG See HOOFED MAMMALS

WASHINGTON, George (1732-1799), the first President of the United States, "the Father of the Republic," was born on 22nd February, 1732, in Westmoreland County, Virginia, and was the great-grandson of John Washington, an Englishman, who emigrated to



Washington, first American President

America in 1657 from his home at Sulgrave, Northamptonshire

At the age of nineteen he began his military career and was later appointed adjutant-general of the Virginia Militia Soon afterwards he took part in the war against the French

About this time he came into the possession of extensive estates and plantations owing to the death of his half-brother, and in 1759 his possessions were further increased when he married Martha Custis

Sixteen years later the question arose whether Britain had the right to tax the American colonies A bitter quarrel ensued which resulted in the War of INDEPENDENCE Washington was elected Commander-in-Chief of the American forces

The new United States had no regular soldiers to stand against those sent out by Britain, but Washington trained his army so well that in the end they forced the British to surrender and peace was signed in 1783

Washington's skill as a soldier had helped the States to win their independence now his ability as a statesman was called on to help them to use that freedom aright In 1787 he was a member of, and presided over, the Convention which met to revise the articles of union between the States The United States of America formed themselves into a republic and George Washington was elected the first President in 1789

He was re-elected in 1793 and at the end of his second term of office in 1797 he resigned, and then retired to Mount Vernon He died there on 14th December, 1799, greatly mourned by men of all parties who recognized him as "first in war, first in peace, and first in the hearts of his countrymen"

WASP See **BEES**

WATER is the liquid compound of oxygen and hydrogen. Its purest form is distilled water. Rain-water contains dissolved gases, water from all other natural sources contains in addition dissolved solids. The important qualities of water are: (1) its great solvent power, which explains why it is essential to all living things, (2) its habit of expansion on turning solid—it is densest at 4 deg C and in cooling from that temperature down to 0 deg C it expands and becomes less dense than the warmer water. For this reason ice forms on top of a pond, with warmer water underneath.

WATER-COLOUR PAINTING, one of the methods used for painting pictures. It is divided into two large classes—transparent and opaque water-colour. In the former the colour fluid is made by rubbing a wet brush on the cake of colour or by mixing water with the paint from a tube. In the second, white is added to the mixture to make the colour opaque. In this second class comes also painting in poster colours or tempera colours or gouache colours, which are bought ready made up in jars.

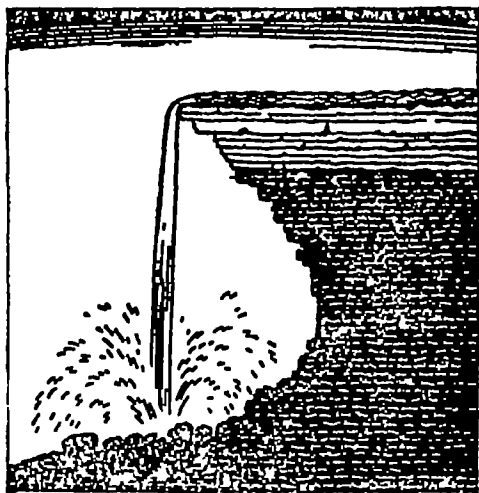
The colour is applied to paper (usually of a roughish texture) with a brush made of soft hair, such as squirrel or sable, but may also be applied (especially if opaque colours are used) with a stiffer brush of hog's hair.

There are two methods commonly used in water-colour painting: (1) the direct method of painting the full strength of a colour directly on the paper, and (2) putting on a wash of the lighter colours first and gradually working them up to the full colour and strength. The wash is put on by filling the brush with the colour fluid and putting it smoothly on to the paper from side

to side of the space to be filled. In the first method the brush is filled with the colour desired and applied directly to the part thus to be coloured. Details and masses are in this way suggested at once instead of being built up wash by wash.

Water-colour painting was used by painters all down the ages, but was brought to perfection in England in the 18th century by David Cox, Paul Sandby, John Sell Cotman, R. P. Bonington and J. M. W. Turner. Since then it has been used everywhere. Recently the opaque method has been used extensively. See **ART** and **PAINTING**.

WATERFALLS occur in rivers where a layer of hard rock joined softer rock. The softer rock has been worn away more rapidly than the harder rock which remains as a ledge. The Niagara Falls (about 165 feet high) on the River Niagara between the U.S.A. and Canada,



Waterfall over ledge of hard rock

and the Victoria Falls (about 350 feet high) on the River Zambezi in Northern Rhodesia, are well known, but the Kaieteur Falls in British Guiana are 741 feet high. Rapids and cataracts are simply miniature waterfalls.

WATER FLEA See CRUSTACEANS

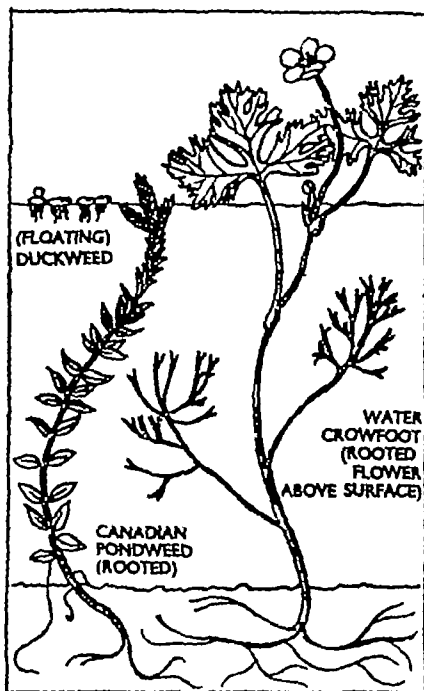
WATER GAS is an inflammable gas for light and power, made by passing steam over red-hot coke

WATER GLASS, sodium silicate, is usually sold as a treacly liquid for making up into a solution with water in which eggs are kept to preserve the contents

WATERMARK, a faint design or name in a sheet of paper made during the course of its manufacture paper is first pulp, which dries in thin layers, the watermark, a raised wire forming the design, is pressed into the pulp, and when the pulp dries the place where the impression was made can be seen by holding the paper up to the light

WATER PLANTS. Some plants like to live in damp, marshy ground, and from these there is a gradual series through swamp plants to true aquatic forms. Water plants near the shore are mostly rooted, have floating leaves, such as those of water-lilies and water crowfoot, or leaves and flowers growing above the surface, like water violet. Some water plants are free-floating, as duckweeds and frog-bit. Others live almost entirely submerged, like Canadian pondweed. In deep water only stoneworts and algal pond-scums can live. Water plants show a wide variety of adaptations to their life in leaf-stem structure, POLLINATION, seed dispersal, etc. See also ALGAE and AQUARIUM

WATER POLO, a ball game played in a swimming bath in not less than 3 feet of water, between two teams of seven players—three forwards, one half-back, two backs, and a goalkeeper. The leather ball is about 27 inches in circumference. The playing area is 19 to 30 yards long by not more than 20 yards wide. At each end is a goal,



Some common water plants

10 feet wide, the crossbar being 3 feet above water, or 8 feet above the bottom of the bath if the water is less than 5 feet deep. A game consists of two periods of 7 minutes each, the teams changing ends at half-time. The game is controlled by a referee and a timekeeper, with a goal-scorer at each end. At the beginning of a period and after each goal the players line up by their respective goals, and the referee throws the ball into the centre. The forwards then swim for the ball, and endeavour to pass it to one another and throw it into their opponents' goal, touching the ball with one hand only. The goalkeeper may not move outside the penalty area which extends 4 yards out from the goal-line, if a player commits a foul in this area, a free throw direct at goal is allowed to the other side, for infringements elsewhere (e.g. holding the ball

with two hands, jumping off the bottom, etc) a free throw is given to the other side If a player throws the ball over his own goal-line, the attacking side is awarded a free throw from the corner to the players clustered in front of the goal

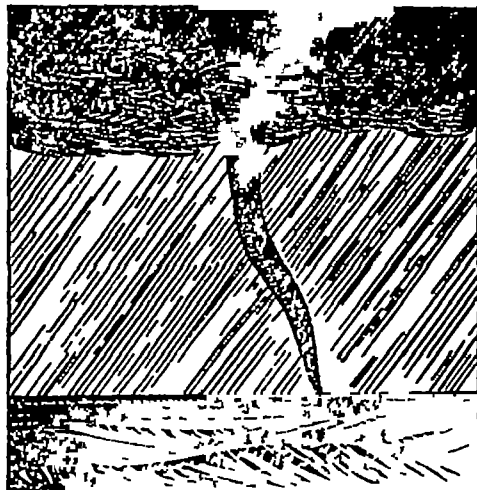
WATERSPOUT, a funnel-shaped, rotating cloud caused by a tornado at sea The cloud, tapering downward to the sea, appears like a spout joining sea to sky

WATER SUPPLY, DOMESTIC. In the old days water was (for all purposes) drawn from streams and shallow wells As the population grew denser the streams became fouled with human and industrial waste, whilst the wells became contaminated by impurities which drained into them Nowadays, therefore, large cities draw their supplies from distant streams and lakes in areas where the chance of fouling is small In order to build up the tremendous stock of water required, large storage reservoirs are constructed into which water is continually pumped, or large reserves can be got by damming rivers and lakes From these supplies the water goes to the waterworks for purification

Domestic water is frequently filtered through large beds of sand and gravel to remove suspended sludge and small plants before being pumped at high pressure to our houses

In addition, all the water is constantly tested and, usually, treated chemically to kill any dangerous organisms which may get into it

The pressure required to pump water to houses in high districts of a big city would be far greater than the pressure necessary for the water to be pumped to low-lying districts It is usual therefore for



Waterspout, formed by a tornado

the water for a high district to be pumped direct into a service reservoir, built at the highest point of the district, and the fact that the water has to fall slightly in coming down to the surrounding houses means that it has sufficient force behind it to ensure it reaching where it is intended to go If the high district has no extra high point for a reservoir, a water tower with a large tank at the top, higher than the surrounding buildings, is erected instead

WATT, James (1736-1819), the most celebrated of British mechanical engineers, was born at Greenock

After spending some time in Glasgow in mathematical instrument making, he went to London at the age of nineteen to learn the trade thoroughly, but his health became impaired and he returned to Scotland

He endeavoured to establish himself in business in Glasgow as a mathematical instrument maker but one of the city guilds opposed his project on the grounds that he had not served a proper apprenticeship Luckily, he received, in 1757, the appointment of mathematical instrument maker to the University

and had his workshop there until 1763. From this time until 1774 he acted as a civil engineer and made surveys for canals and harbours. It was during this period also that he did his pioneer work in connexion with the steam engine. At Glasgow University there was a model of Newcomen's engine, the best which then existed. It was almost entirely used for pumping water, mainly in connexion with the draining of mines. It was not long before Watt had found out all the defects of this engine and obtained, through experiment, ideas for a number of innovations for a more efficient model, and an engine embodying all his new ideas was built by the Carron ironworks.

Watt's innovations changed the steam engine into a faster working, more powerful and effective machine, that could be used to drive different kinds of machinery, so that he really made the steam engine very much what it is today.

In 1774 Watt joined with Matthew Boulton to form the firm of Boulton & Watt for the manufacture of steam engines.

WAVE, any regular vibration in the particles of a substance or in space. See **CURRENT**, **LIGHT**, **SOUND**, **WIRELESS**.

WAX, solid substance characterized by the fact that it melts at low temperatures, burns easily, and is fairly resistant to chemical at-



Watt experimenting with his steam engine

tack. **Waxes** are used for candles, polishes, and cosmetics. Common examples are bees-wax and paraffin wax.

WAXBILL. See **CAGE BIRDS**.

WEALTH from the economist's point of view is not money but is rather the things that money can buy. These must be things that people want, they have no value if nobody wants them.

In ordinary speech, wealth is contrasted with poverty, but even the poorest has some wealth, for if he had nothing he would die. A poor man has few things, a rich man many. **PRODUCTION** is undertaken in order to produce wealth and the greater the efficiency of labour and capital, the greater will be the wealth produced.

WEASEL, a FLESH-EATING MAMMAL very like a STOAT, but smaller and more slender. The fur is more reddish-brown, the tail has no black tip. It preys on mice and other small RODENTS. Though often destroyed as vermin, it helps to preserve man's food stores.

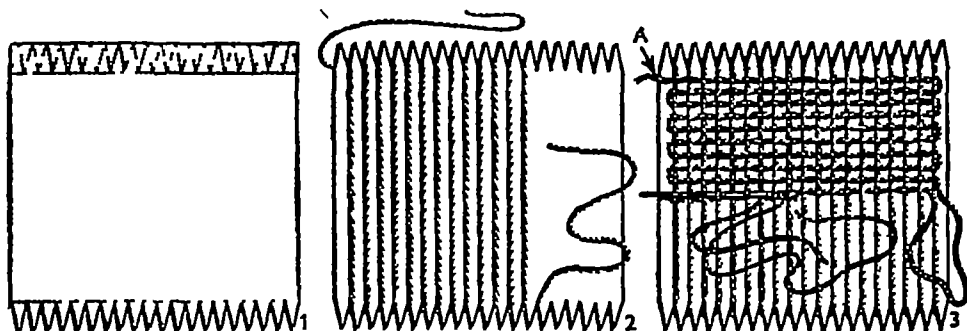
WEAVING is the making of cloth material by darning one set of threads over another. The first set is the warp, and the threads darned across them are the weft.

To keep the warp threads tight enough to be darned over they must be stretched tightly over a foundation called a loom. This may

at A, pick up alternate threads. When the end of the row is reached weave back again, going under the threads that were picked up in the first row. Do not tie a knot at the beginning. All joins in weaving are overlapped, there are no knots anywhere in the weft (see 3).

A new colour may be joined to form a striped pattern, or the pattern may be kept in one colour. A checked mat can be made by striping warp and weft.

Take great care not to draw in the weaving. Allow the warp to lie loosely, and press down each row with the finger-tips or a clean



On this simple loom first the warp is woven and then the weft

be made from a piece of cardboard notched at each end to take the threads.

To make a square mat, take a piece of cardboard 5 inches square, rule lines $\frac{1}{2}$ inch from each of two opposite ends and on these lines mark every $\frac{1}{4}$ inch in pencil. Then cut points from each mark (see 1). Take a long piece of thick wool or knitting cotton. Leave a long end, and wind the wool round the points and across the face of the card so that one side of the loom is covered with wool. Tie the end of the wool to the long end at the back of the loom (see 2).

To weave, take a bodkin or large darning needle. Thread it with wool and starting close to the points

comb. The comb teeth should be far enough apart to allow a thread between each tooth.

When finished, lift the warp off the pointed ends of the loom, and darn in all loose threads.

To make a kettle holder, or a bag, tie the warp thread right round the loom and wind the warp round and round between the points so that both sides are covered with wool.

The weft is done in the same way, but now the thread goes down one side, over the loom and up to the top again. The thread is then taken back the same way leaving one edge of the cardboard loom showing but the other completely hidden. When the weaving is finished, bend

the loom in the middle, free it from the wool, then withdraw it through the open end of the work

The rim of the open end is then oversewn, and a loop sewn on, by which it can be hung

If a bag is wanted, leave the end open and thread a piece of ribbon or cord through the weaving, which can be pulled tight to close the bag

Many other things can be made by varying the size or shape of the loom, such as berets collars, slippers, tea-cosies, etc

WEED, useless or injurious wild plant growing where it is not wanted and robbing the soil of food and moisture which should be available to cultivated plants Weeds harbour **PESTS** and diseases which may infect growing crops All annual weeds should be kept down, by **HOING** preferably, while they are still young so that they never reach the seeding stage Deep-rooted **PERENNIAL** weeds like



Weeds every gardener knows

dandelion, thistle, couch grass (see illustration) can only be got rid of by being dug up

WEEVIL See **BEEBLE**

WEIGHT. See **DENSITY, GRAVITY**

WEIGHTS AND MEASURES.

Avoirdupois

16 drams	1 oz (ounce)
16 oz	1 lb (pound)
14 lb	1 stone
28 lb	1 quarter
4 quarters	1 cwt (hundred-weight)
20 cwt	1 ton

Troy Weight

24 grains	1 pennyweight
20 pennyweights	1 oz

Apothecaries' weight

20 grains	1 scruple
3 scruples	1 dram
8 drams	1 oz
12 oz	1 lb

Long Measure

12 inches	1 foot
3 feet	1 yard
5½ yards	1 rod, pole, perch
22 yards	1 chain
10 chains	1 furlong
8 furlongs	1 mile

Nautical Measure

6 feet	1 fathom
100 fathoms	1 cable
10 cables	1 nautical mile

Square Measure

144 sq ins	1 sq ft
9 sq ft	1 sq yard
30¼ sq yards	1 sq rod
40 sq rods	1 rood
4 roods	1 acre
640 acres	1 sq mile

Liquid Measure

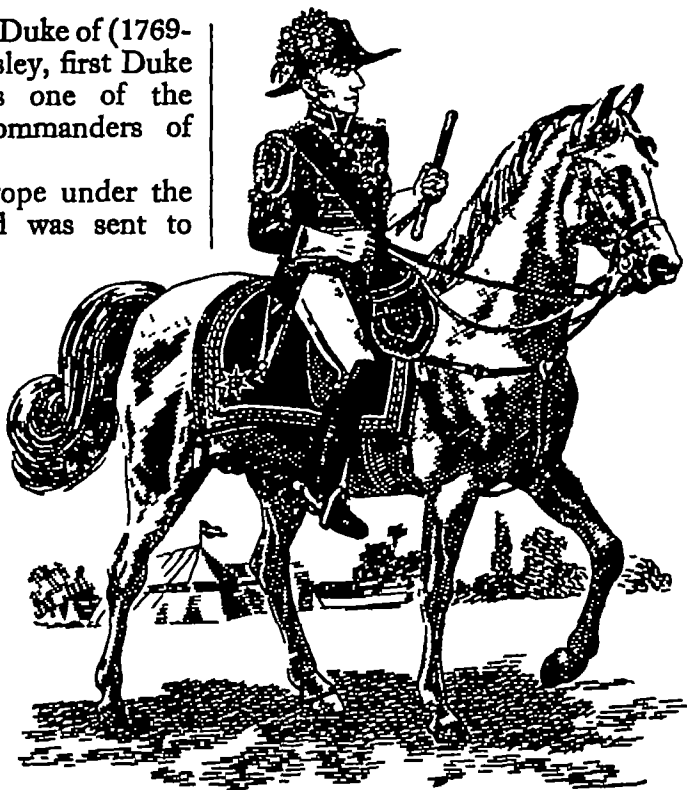
4 gills	1 pint
2 pints	1 quart
4 quarts	1 gallon

Dry Measure

2 pints	1 quart
4 quarts	.. 1 gallon
2 gallons	.. 1 peck
4 pecks	. 1 bushel
8 bushels	.. 1 quarter

WELLINGTON, Duke of (1769-1852) Arthur Wellesley, first Duke of Wellington, was one of the greatest military commanders of modern times

He served in Europe under the Duke of York, and was sent to India (1796). He conquered Mysore and broke the power of the Mahrattas, with whom Napoleon had friendly relations. In 1808 he began his Peninsular Campaign to drive Napoleon's troops out of Spain and Portugal. After defeating the French at Talavera (1809) he was made Viscount Wellesley. By his famous defences, the Lines of Torres Vedras, Wellington defended Lisbon, and secured his lines of communication by sea. In due course he entered Madrid in



Duke of Wellington rides to inspect his troops



H. G. Wells, novelist and social critic

triumph. But it was at Vittoria he won his most decisive victory which forced the French back across the Pyrenees. He followed them into France and inflicted another defeat at Toulouse, after which he was made Duke of Wellington. These victories, together with the French retreat from Moscow, brought about the downfall of Napoleon.

After Napoleon's escape from Elba, Wellington with the Prussian Blücher met and defeated him in Belgium at the Battle of Waterloo (18th June, 1815). Then Wellington took a large part in political affairs. He organized the military in London at the time of the CHARTIST RIOTS.

WELLS, Herbert George (1866-1946), while young was apprenticed to a draper, an experience made use of in his early novels, *Kipps* and *The History of Mr Polly*. He be-

came a pupil-teacher, however, and took a degree in science at the University of London. He gave up teaching in 1893 for writing.

His earlier work includes a number of scientific romances, such as *The Time Machine*, *The War of the Worlds*, *The First Men in the Moon*, *The Invisible Man*, in which he imagines possible developments of science. Other works of fiction give us pictures of society and character from the standpoint of a socialist who would like a more rational and equitable world. These include *Ann Veronica* and *Tono-Bungay*, *Mr Britling Sees it Through*, and *The World of William Clissold*. *The Country of the Blind* is a collection of short stories.

Wells wrote a great deal of non-fiction—tracts, popularizations of science, *The Outline of History*, *The Science of Life* and an interest-



Scene from Wells's "*The Invisible Man*"

ing autobiography. He endeavoured to make modern men more conscious of their history and especially of the place that science now holds in their lives.

WESLEY, John (1703-1791), was ordained DEACON in the CHURCH OF ENGLAND in 1725. He travelled all over England preaching, with the help of his brother Charles, who wrote 5,000 hymns, including "Jesu, Lover of my Soul." The two brothers founded the METHODIST Church.

WEST AFRICA, is a tropical region of hot, damp climate mostly covered inland by dense equatorial forest, and bordered in the north by the Sahara desert. There are few white inhabitants. See BELGIAN CONGO, CAMEROONS, FRENCH EQUATORIAL AFRICA, FRENCH WEST AFRICA, GAMBIA, GOLD COAST, LIBERIA, NIGERIA, SIERRA LEONE. See map of AFRICA.

WEST INDIES, a group of islands off Central America, many of them CORAL islands and some volcanic. The climate generally ranges from sub-tropical to tropical,



John Wesley, the first Methodist

and sugar, spices and tropical fruits are the main exports. Most of the inhabitants are descendants of African slaves imported to work the sugar plantations, most of them having some Spanish or other European blood, or even that of the original Carib inhabitants. In many of the islands, French or Spanish are the native tongues. The two largest, CUBA and HAITI, consist of independent republics, and the rest are British, American, French or Dutch colonies. The islands are divided into two main groups, known as the Greater and Lesser Antilles, the former include Cuba, Haiti, JAMAICA and PUERTO RICO, the Lesser Antilles stretch from the Virgin Isles down to TRINIDAD off the South American coast. See also BAHAMAS, BARBADOS, MARTINIQUE, and map of CENTRAL AMERICA.

WHALE. Whales are not fish at all, but warm-blooded, air-breathing sea MAMMALS. Blue whales are the biggest animals that have ever lived, reaching 90 feet in length and 300 tons in weight. The Sperm Whale is fond of the warmer parts of the oceans. Whalebone whales grow sieves of horny material from

the roofs of their mouths, through which the minute animals on which they feed are strained. Many whales have a deep layer of fat, the blubber, underneath their skin, which prevents them from losing heat. They swim by means of the two huge horizontal tail flukes. Whales are descended from land-living mammals, and deep within their bodies are the remains of hind legs. The "blow-hole" is the whale's nostrils, placed high on its head, from which is forced the "spout" of its outgoing breath.

The dolphin and porpoise are related animals. The Killer Whale is really a species of dolphin.

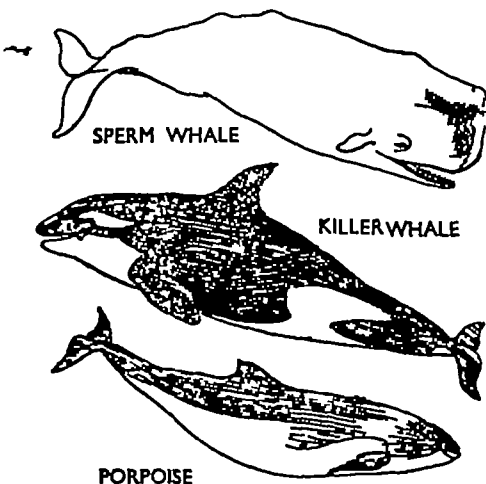
WHALE OIL is the liquid fat obtained from whale blubber. It is used for soap manufacture, and after HYDROGENATION as a hard fat for incorporating in margarine and cooking fats.

WHIGS. See **TORIES AND WHIGS**.

WHIRLPOOL, a circular eddy in a river, lake or sea caused by the meeting of two currents, by winds, or by a tidal current sweeping through a narrow channel. It is dangerous to swimmers, and even, when big enough, to small vessels.

WHITEHALL is a street in London in and about which are situated many of the Government offices. Downing Street, with the residences of the PRIME MINISTER and CHANCELLOR OF THE EXCHEQUER, is a street running off Whitehall.

WHITTINGTON, Dick, the hero of pantomime, was a real person, though many of the stories about him and his cat are more or less fanciful. He was the son of a Gloucestershire gentleman, who became a successful London merchant. He was Lord Mayor three times, and entertained King Henry V and his French bride at a splendid banquet, during which he



Some of the whale family



Wilberforce helped to end slavery

burnt the receipts for £60,000 which he had lent the king to carry on his war in France—he thus made the king a present of that money, and the king knighted him. Sir Richard spent large sums of money in helping the poor, rebuilding hospitals and improving the conditions in prisons. What about his Cat? The cat story may have come from an old French word *achat* which meant “to buy and sell at a profit.” In course of time it became “*acat*,” and it may be that people spoke of Whittington as becoming a rich man through *a cat*, meaning through trading at a profit.

WHOLESALE, one who buys goods in bulk. There are two main groups of wholesaler (1) those who buy from farms and mines to sell to the manufacturer, (2) those who buy from the **MANUFACTURER** to sell to the **RETAILER**. When wholesalers buy, say, fruit in large quantities from the fruit grower, they are wholesale fruiterers. If they buy boots in large quantities from manufacturers, they are wholesale boot dealers. They in turn sell to retailers, who sell to the public,

the final consumers. They are of service to the primary producer, such as a farmer, because they give him a ready and a known market. The farmer grows in order to sell; he may be a good farmer but a poor seller. The wholesaler relieves him of the specialized work of selling.

WILBERFORCE, William (1759-1833), was an English reformer and politician. He is chiefly remembered for his great work in connexion with the abolition of **SLAVERY**. He toiled for twenty years (1787-1807) before he saw a Bill passed which put an end to the Slave Trade, and he lived just long enough to hear the good news that all the slaves in the British Empire were to be set free.

WILD CAT. See **CAT**.

WILD FLOWERS are one of the greatest delights of the British countryside, and the names, form and colour of the most usual should be known to every boy and girl.

Spring is one good time to look around you when you are amidst the fields and hedgerows, for then the leaves are beginning to unfold and assume their varied shapes (see **LEAF**), ready to help the new plant to live and grow (see **PHOTOSYNTHESIS**). Later on, in their due season, the flowers will blossom gaily decorating their green or brown background, and on each finished **FLOWER** the wind, the birds and the insects will get to work, taking pollen to stigmas and creating new **SEEDS** for plants the following year (see **POLLINATION**). See the pictures on pages 620-621.

WILL, a legal document in which a person sets out how his property (money, house, etc.) shall be disposed of after his death. Money or articles inherited under a will are called a *legacy*. The property which a person leaves is called his *estate*.

EARLY PURPLE
ORCHID

ROSE BAY WILLOW HERB
(PINK)

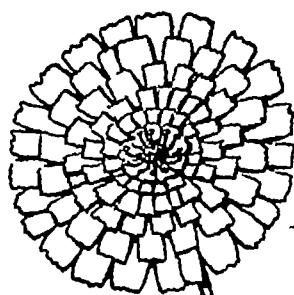
GOAT'S BEARD
(YELLOW)



COLT S-FOOT
(YELLOW)



WILD APUM
(PALE GREEN)



HEARTSEASE
(PURPLE YELLOW)

Wild flowers, with their many bright, gay colours and varied heights and shapes,



add to the glory of the countryside, as they sway in the breeze See page 619

WILLIAM I, The Conqueror (reigned 1066-1087), was the son of Duke Robert of Normandy, and a descendant of a famous Northman, Rollo, who invaded France at the beginning of the 9th century.

William was a cousin of Edward the Confessor, king of England, and he declared that Edward had promised him the crown. On Edward's death, Harold, Earl of Wessex, was chosen as king, and William invaded England to take the crown. Harold was defeated and slain in the Battle of Hastings (1066), and William became king of England. The story of the invasion is told in a wonderful series of needlework pictures, the **BAYEUX TAPESTRY**, which was probably made by Matilda, William's wife, and her women friends. William entered London and was crowned king in Westminster Abbey on Christmas Day.

There were several risings before William fully subdued the country. One of the most famous of the English leaders was Hereward the Wake, who had a camp in the Isle of Ely (1070-1071). In order to control the country, William built many strong castles, each containing a garrison of soldiers.

The illustration shows us a typical Norman castle. Originally, it was a wooden building inside a wooden palisade, built on a high mound surrounded by a moat, but later the building and palisade were replaced by stronger stone structures, the wall having a sturdy gate and towers built in to serve as shelters for the defenders. The big central building was known as the keep and the wall as the bailey, a term often applied to the yard inside the wall. Later, a wall was built out round the original gate, and this wall had a rampart (the battlements) from which the castle

defenders could throw missiles on to any attackers. Access across the moat to the main gate was by means of a drawbridge which could be pulled up when danger threatened, and each gate could be closed by a portcullis, an iron grill which slid up and down and through which arrows could be shot at any attackers.

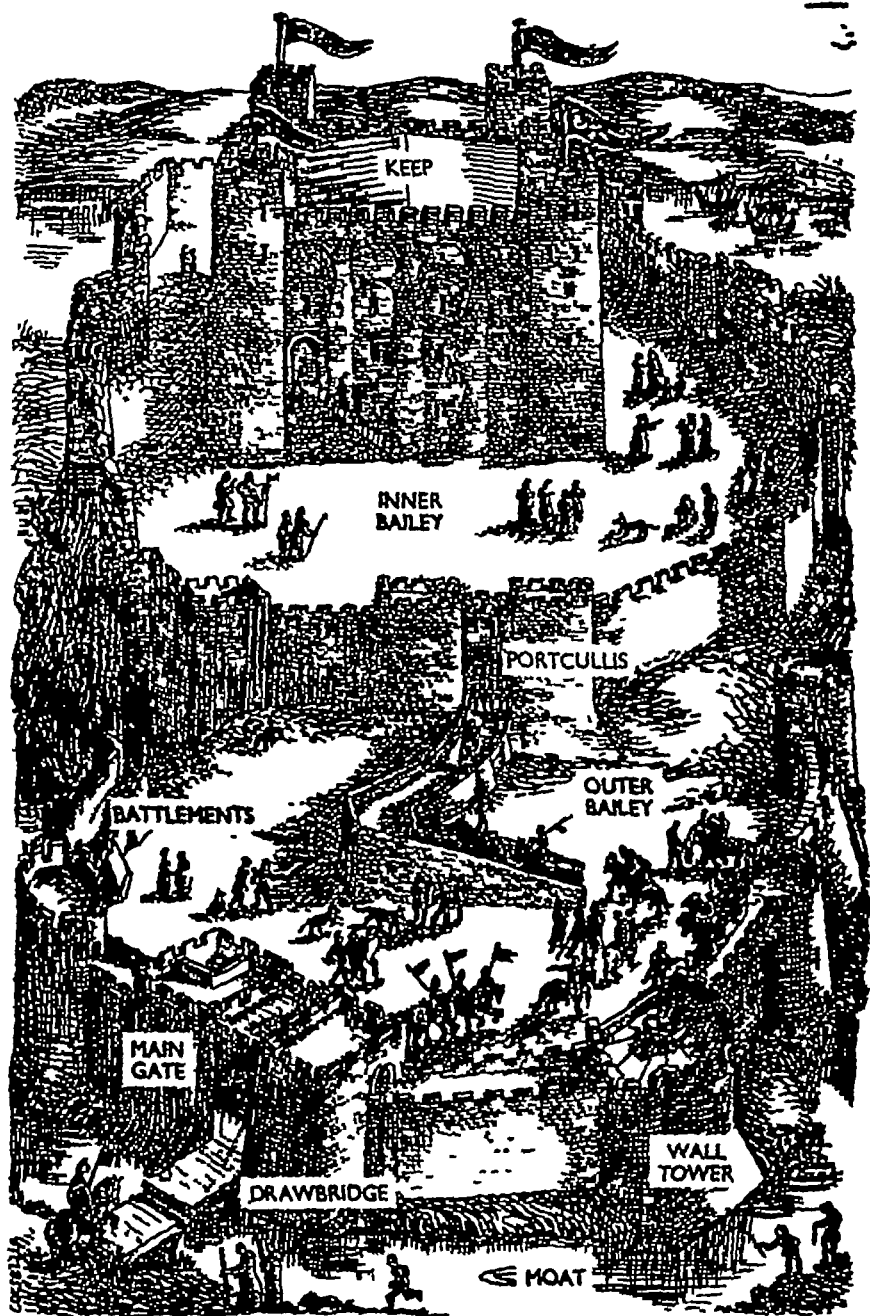
In order to levy taxes fairly, it was necessary for William to know who held land, and how much the land was worth. He therefore had a survey made of the whole kingdom, and the particulars were entered in a book, **Domesday Book** (1085).

WILLIAM II (reigned 1087-1100), called Rufus, "the Red," was the second son of William the Conqueror. He succeeded to the Crown of England, while his elder brother Robert became Duke of Normandy. William was killed by an arrow while hunting in the New Forest.

WILLIAM III (reigned 1689-1702) He was Prince of Orange, and a grandson of Charles I. He married his cousin, Princess Mary, daughter of the Duke of York (James II). William became the champion of the Protestant cause in Europe, and was invited by some of the chief men of England to come over and take the Crown when his father-in-law, the Catholic **JAMES II**, fled to France. William and Mary were crowned King and Queen in 1689. He defeated James in Ireland at the Battle of the Boyne (1690).

In his reign were passed the Bill of Rights (1689) making England a constitutional monarchy with Parliament as the supreme factor, and the Toleration Act (1689) which gave Nonconformists the right to worship in their own way. In his reign England began to resist the power of Louis XIV of France.

In 1701 he secured the passing of the Act of Settlement by which



William I introduced the Norman castle into England at first a wooden building inside a wooden palisade, erected on a mound surrounded by a moat, it later developed into a sturdy stone structure defended by a stone wall. To defend the gate in the wall, a second wall was built out, having towers and a main gate with a drawbridge which could be pulled up when an enemy approached

the English Crown passed on the death of Queen Anne to the Electress Sophia of Hanover and her heirs, who were Protestants, thus excluding the Catholic descendants of James II. The Electress was a grand-daughter of James I.

WILLIAM IV (reigned 1830-1837), the third son of George III, succeeded his brother George IV as king of England. His reign is important on account of the passing of the great Reform Act of 1832.

WILLIAM THE CONQUEROR. See **WILLIAM I**.

WILSON, Thomas Woodrow (1856-1924), was elected President of the United States in 1912 and again in 1916.

His period of office is memorable for the entry of the United States into the **FIRST WORLD WAR**. He played a great part in planning the Peace Conference, and founding the **LEAGUE OF NATIONS**, but failed to win the support of the United States for the League. This was a great disappointment to the President and his health gave way.

WIND. The equatorial zone of the earth is a region of great heat and moisture known at sea as the **DOLDRUMS**, where low pressures prevail. Strong winds blow towards the equatorial low pressure belt from the high pressure belts known as the **Horse Latitudes**. As they blow towards the **EQUATOR**, the winds are deflected by the rotation of the earth and appear to blow from the north-east in the northern hemisphere and from the south-east in the southern hemisphere. They are the **North-East and South-East Trade Winds**. Winds also blow from the **Horse Latitudes** towards the **POLES** from the south-west in the northern hemisphere and from the north-west in the southern hemisphere. These are the **Westerlies**, often called the

"**Roaring Forties**," or "**Brave West Winds**" in the southern hemisphere.

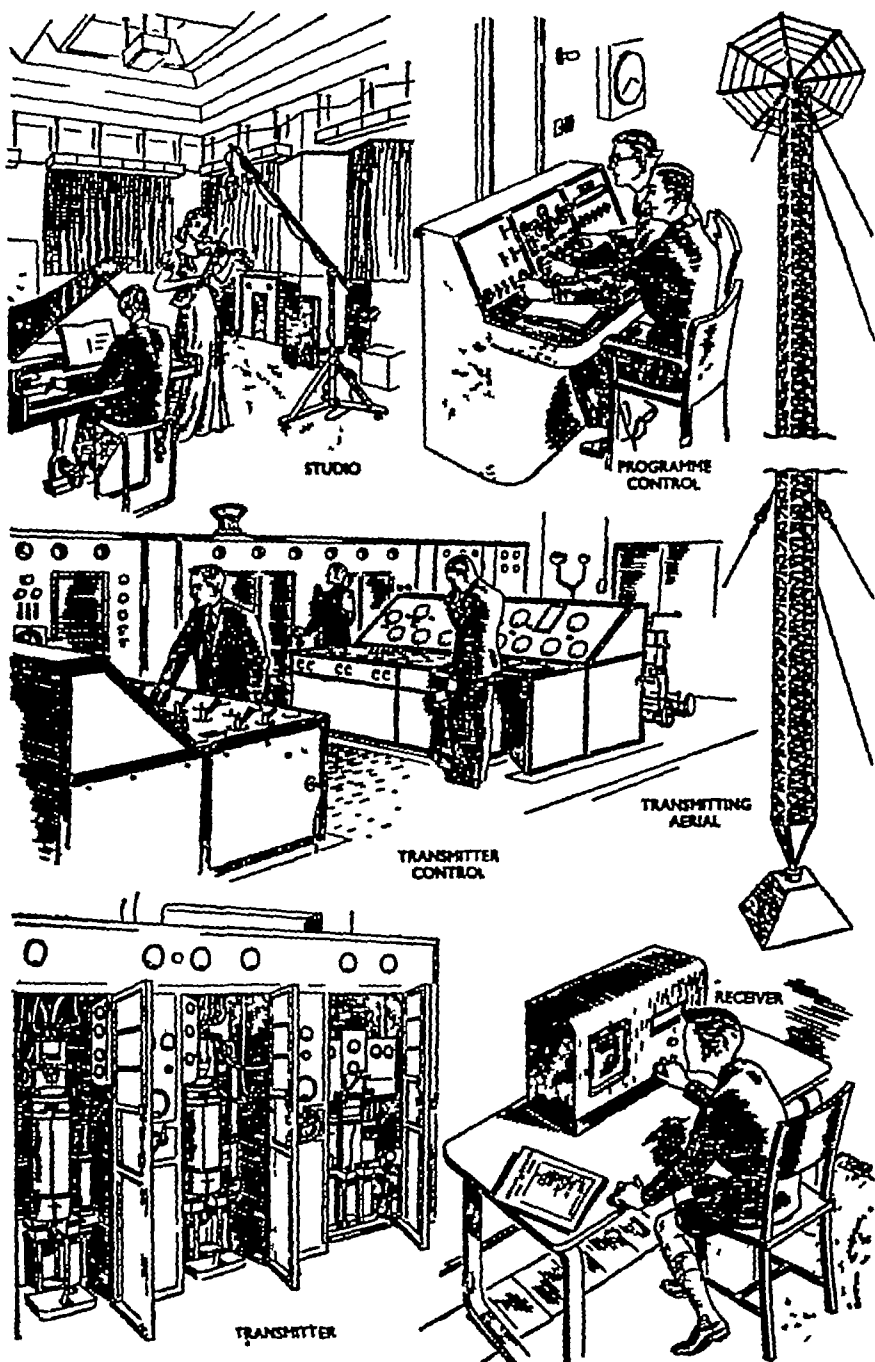
The **Trades and Westerlies** comprise the system of winds which prevail over the oceans and the coastal margins of the continents. They swing north and south with the overhead sun. In certain places local winds have marked climatic effects: the **Chinook**, which blows over the **Rocky Mountains**, is a warm, dry wind which melts the snow; the **Harmattan** and **Sirocco** are hot, dry winds which blow out from the **Sahara** to the south-west and north respectively—the **Harmattan** has a bracing influence, but the **Sirocco** has a scorching effect on Southern Europe in summer; the **Mistral** is a cold, biting wind which blows in winter and early spring down the **Rhône valley** in France.

Gales are very strong winds but they are not as violent as hurricanes which often reach a speed of a hundred miles an hour and cause damage to crops and buildings in tropical regions. Sandstorms occur in desert areas where loose sand is lifted by sudden winds in whirling clouds. Typhoons are violent cyclonic storms which occur off the east coasts of Asia. Whirlwinds are violent winds which swirl forward in a spiral shape. See **ATMOSPHERE**.

WIND TUNNEL, an open-ended box of great size through which air can be blown at any required speed. Inside the box are suspended models of aircraft, and their behaviour at high speeds can be examined.

WIRELESS. A wireless transmitting station produces wireless waves, a kind of alternating electric **CURRENT** sent through space, which will affect wires many miles away.

The amount of current movement produced by the transmitter depends on a **MICROPHONE** which



Wireless is now part of our daily lives, and the illustration shows the steps in broadcasting sounds in the studio are picked up by the microphone and effect 'an electric current, which is transmitted from the aerial Receivers pick up the transmission and render it back into sounds again

is affected by sounds near it. Thus sounds in the transmitting studio are transformed into electrical waves which are radiated into space from an aerial

When these radiated waves strike the aerial of a receiving station or set, they cause the electrons in it to oscillate with the frequency of the transmitted wave. These oscillations are rectified by a crystal or thermionic VALVE and amplified before going on to the earpiece or LOUDSPEAKER.

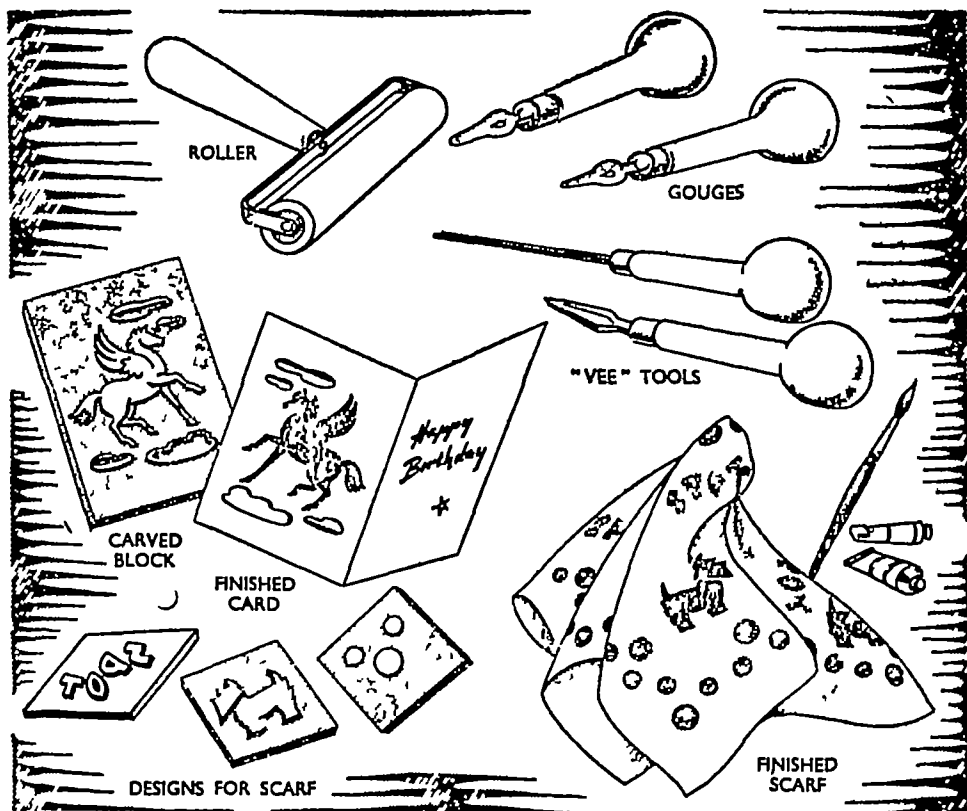
There are at any time many waves of different lengths which are affecting any receiving aerial, but a set can be tuned to receive only one wave-length by adjusting a CONDENSER so that the set is in tune with the selected transmitter. The wireless receiving set is now a feature of the home.

WOAD is a blue dye, obtained from the plant of that name, used by the Ancient Britons for staining their bodies.

WODEN, or Odin, is the chief of the gods in Norse MYTHOLOGY. Wednesday is named after him.

WOLF. See DOG.

WOOD. In forestry, TREES are grown as a crop, often to be felled for timber. Timber must be seasoned, in air or a kiln, or it will warp and split. Wood is treated to make it more resistant. Certain woods are very durable and resist attacks of fungus (causing dry-rot) or insects (wood-worm and death-watch beetles) for centuries. Some trees yield a coarse-textured wood like oak, others like boxwood are fine-textured. Different woods are used according to qualities desired, e.g. strength, flexibility, hardness.



Tools and designs for making lino-cuts, which are easier than wood-cuts

WOOD-CUT, a picture print, usually black and white, made by a flat block of wood (usually box-wood) which has been treated as follows the artist draws his picture on the block and cuts away those parts he wishes to appear white on the print, leaving the areas forming lines and shadows. The latter when inked over and pressed on the paper will form the picture. In another method the artist engraves or gouges out the lines and shadows, leaving the rest intact, this is called the white-line method, because the picture appears as white against black.

A simpler method (frequently used in schools today) is by the use of a plain thick *linoleum block* instead of wood, the linoleum being easier to gouge. The picture is drawn, or traced from a drawing, on to the linoleum and the parts to be cut away indicated by white paint or chalk. Those parts are then cut away with steel gouges and the block is ready to print from. The block is inked by a roller with printer's ink, and thin paper (Japanese mulberry is best) is damped and put on top. The back of the paper is then rubbed all over with an implement called a baren, or with the back of a large spoon, and the print made.

WOOD, FABRICATION OF.

At one time, all wooden articles were made by hand. Nowadays nearly all the processes of manufacture are carried out by machines in a fraction of the time. Boxes, window frames, tables, for example, can be made by machinery if it is required to turn out a large number of the same pattern of each. But when only a few of a particular pattern are wanted they must be made by hand, since the use of machine tools would be too expensive. See **TOOLS** and **WOODWORK**.

WOODWIND, musical instrument made of wood, containing a column of air set in motion by the performer's breath. By means of holes in the tube uncovered at the wish of the player, the length of the air column vibrating can be altered, so altering the **PITCH** of the note produced. Woodwind instruments are part of an **ORCHESTRA** or **BAND**. See **FLUTE**, **PICCOLO**, **REED INSTRUMENTS**.

WOODWORK. For woodwork a set of good tools is the first necessity. They should be well cared for and used properly. See illustrations under **TOOLS**.

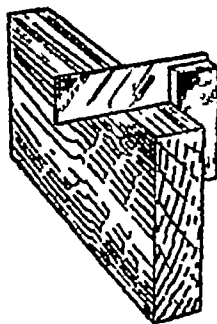
Saws. A hand saw is used for cutting along planks or for all long cuts. No force must be used when sawing and the eyes must be directly above the line of the cut or the saw will stray. Never complete the cut without holding the pieces, or one piece will fall away and break unevenly at the corner.

The tenon saw is used for all smaller cuts, especially across the grain of the wood, making tenons, etc. Using force is liable to bend the saw, and straight cuts will become impossible.

Planes. A jack plane is used for planing edges. A ruled pencil line is required to mark the extent of the planing. Use the square frequently over the edge to ensure

that the edge is rectangular. This must be done along the whole length of the edge, it must touch everywhere.

The smoothing plane is used on surfaces. It should be set finely. Plane in the



Testing the edge

direction of a rise in the grain of the wood, but where it is complicated or a small knot exists, use the plane diagonally across or with a semi-circular motion

Chisels These have many uses, but are mostly required in making such things as mortises. The method of using them is described in the paragraph on Joints

Hammer This should be a medium size, one with a claw end is useful for lifting nails

Gunlets Two or three sizes are necessary. Holes bored for screws must not be smaller than the shaft of the screw used

Square This tool always requires a perfectly straight edge to the wood being worked upon before it is of use for drawing lines

Brace When boring holes right through wood with a centre or twist bit, cease boring immediately the point appears on the other side. Reverse the wood and finish boring from that side. There will then be no splintering

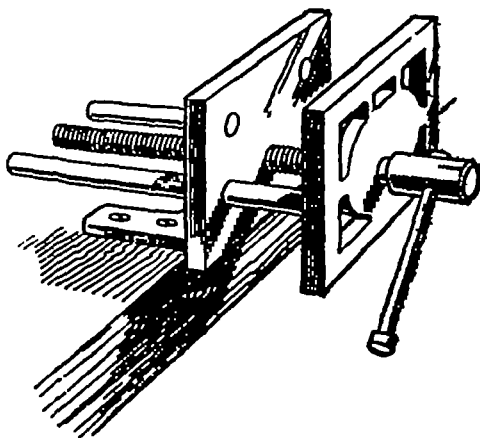
Marking-gauge As with the square, this tool must have straight and true edges. Don't set the point too deeply. Press very lightly or the point will run along the irregular lines of the wood-grain. This tool is particularly useful when accurate markings are required for mortises and tenons, etc

Mallet This is used chiefly for tapping the chisels. It is unnecessary to hit hard. Sharp tools require only light taps, then the chisel is less likely to shift its position

Pliers A pair with a wire cutter is more useful generally

Nail-punch This is for driving nail heads below the surface of the wood, the hole being filled with plastic wood

Vice A woodworker's vice is almost indispensable for good workmanship. Wood must be held firmly

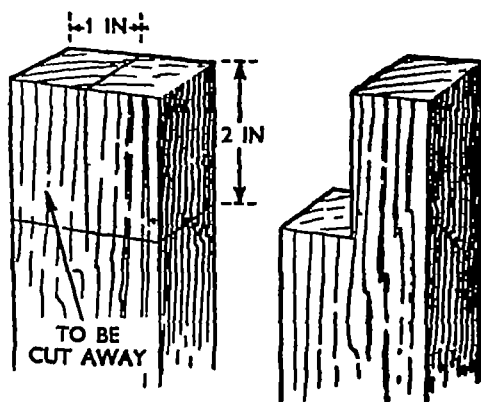


Vice for holding wood firmly

when being planed or chiselled. A less convenient method is to use several cramps

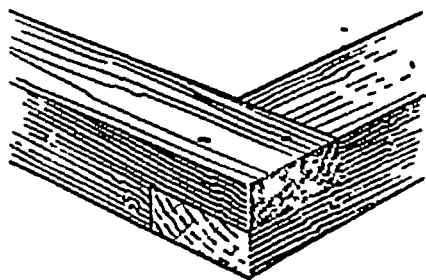
Bradawl, file, screwdriver, two-foot rule, sandpaper, glue are also useful. These do not need description, for their uses are obvious

Joints The simplest joint is the half joint. It is used in shed or hutch building, but not for any furniture piece. To join two battens of 2 inch \times 2 inch wood like an L, the ends must be perfectly squared. Measure off 2 inches from the end on all four sides and rule a line right round it. Next measure 1 inch from the sides on this line and also at the top. Draw lines across the end and along the sides. Mark the piece to be cut away with



Cutting wood for half joint

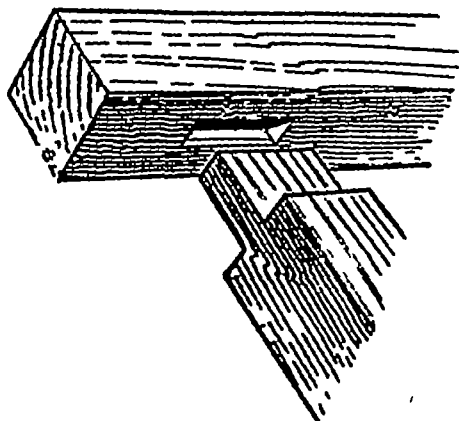
the pencil Next saw down the middle along the grain, first being careful to leave the pencil lines showing on the half to be retained



Half joint complete

Then saw across and the piece should fall out. Repeat on the other piece and the two pieces are ready to be screwed or nailed together

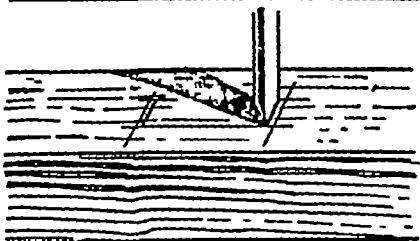
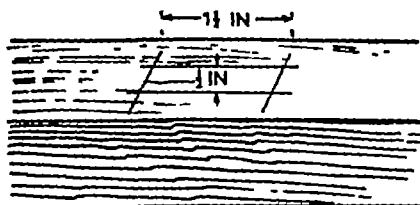
The mortise and tenon joint has far more strength and is used frequently in furniture The tenon and the mortise should be one-third of the thickness of the wood Take two pieces of $1\frac{1}{2}$ inch batten to make a T shape as an example In the



Finished mortise and tenon

centre of the top piece rule two lines across, $1\frac{1}{2}$ inches apart, using the square for this Between these lines rule two lines horizontally $\frac{1}{2}$ inch from each side The marking gauge may be used for this, the point will

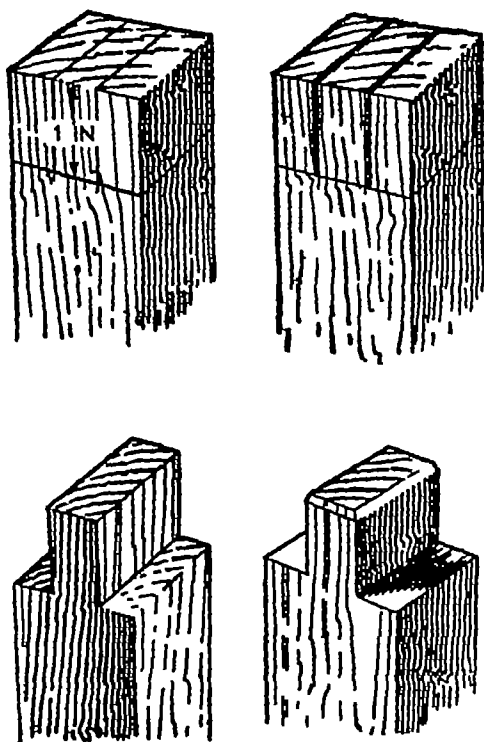
make a groove and this guides the chisel The wood must be held firmly while the mortise is being made In this case the chisel must not be wider than $\frac{1}{2}$ inch Hold it vertically a little away from the end of the mortise and a tap with the mallet will drive the chisel about $\frac{1}{4}$ inch into the wood Repeat at



Chiselling out the mortise

the other end of the mortise Then holding the chisel on a slant about $\frac{1}{4}$ in from the end, make a series of cuts towards the end, always cut with a chisel by pushing it away from yourself Turn the wood round and do the same at the other end The chips are easily removed, but must never be levered out with the chisel or the ends of the mortise will become bevelled Keep on repeating this process until the hole is 1 inch deep Then trim up the ends and sides accurately to the pencil lines, keeping the sides of the hole perfectly vertical

For making the tenon the wood must be perfectly squared at the end Measure off 1 inch from the end and rule a line all round Draw two lines $\frac{1}{2}$ inch from each side over the end Hold the wood vertically in a vice and saw down to the cross lines, leaving the pencil lines showing When cutting away the side pieces be very careful not to cut into the tenon, it would weaken it The shoulders now showing must never slope or a close fitting is impossible, rather tend to make the cuts inwards



Cutting out the tenon

Slightly bevel its end with a chisel: this prevents splintering The tenon should fit tightly into the mortise, but should not be too thick or it may split the wood of the mortise when you force it in.

WORDSWORTH, William (1770-1850), was born and spent most of his life among the hills and dales of the lovely Lake District

He lived at Hawkshead with his brothers and sister Dorothy, and was educated at the Grammar School there, William finding in his sister a close and understanding friend In 1790 he went on a walking tour in France and Italy The FRENCH REVOLUTION was at first an inspiration to him but later a disappointment to his hopes On his return to England, however, he lost his interest in revolutionary politics, and after meeting the poet COLERIDGE settled for a time with him and Dorothy Wordsworth in Somerset Now he began to write some of his best known and most individual work. In 1799 he moved to Grasmere, spending the rest of his life at one home or another in the Lake District In 1802 he married, and in 1813 he was given a government post which ensured him comparative prosperity In 1843 he was made POET LAUREATE

Wordsworth is the poet of the country and nature The natural world he thinks of as a living whole, in which, and through which, breathes spiritual power Many of his poems express the feelings aroused in him by flowers, birds and landscapes, and he writes, too, of simple country people, who, living close to the beauties of nature, were more likely, he thought, to be sincere, affectionate and high-minded than the grosser city dwellers In *The Prelude* and *The Excursion* he describes his own life and development as a poet In the main he uses simple language, as he held that the language of poetry should be drawn from the words of everyday speech.

His poetical works are very numerous and only some of the most important are mentioned here *Lyrical Ballads*, *Lines Composed above Tintern Abbey*, *Lucy*, *The Prelude*, *To the Cuckoo* *The Green*



Wordsworth, poet of Nature

Lanet, The Daffodils, She was a Phantom of Delight, The Solitary Reaper, To a Skylark and Ode Intimations of Immortality

WORLD. Geographically the world consists of the great land masses of Europe, Asia, Africa, Australia, North and South America, and a large number of islands. The chief expanses of water are the Pacific, Atlantic, Indian, Arctic and Antarctic Oceans. The world is divided into five great zones of TEMPERATURE parallel with the EQUATOR. round each POLE is a frigid zone, round the equator is the torrid zone, and between the frigid zones and the torrid zone come the temperate zones. See CLIMATE, EARTH, STANDARD TIMES, and the entries under the names of the various countries, continents and seas.

The history of the world shows how the early wandering bands of primitive men, living by hunting animals, settled down to become farmers (see **STONE AGE**). Later,

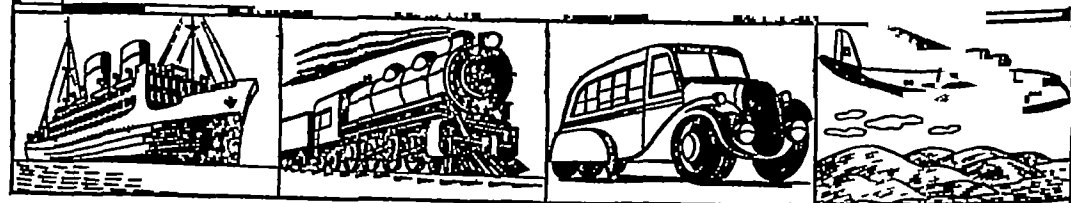
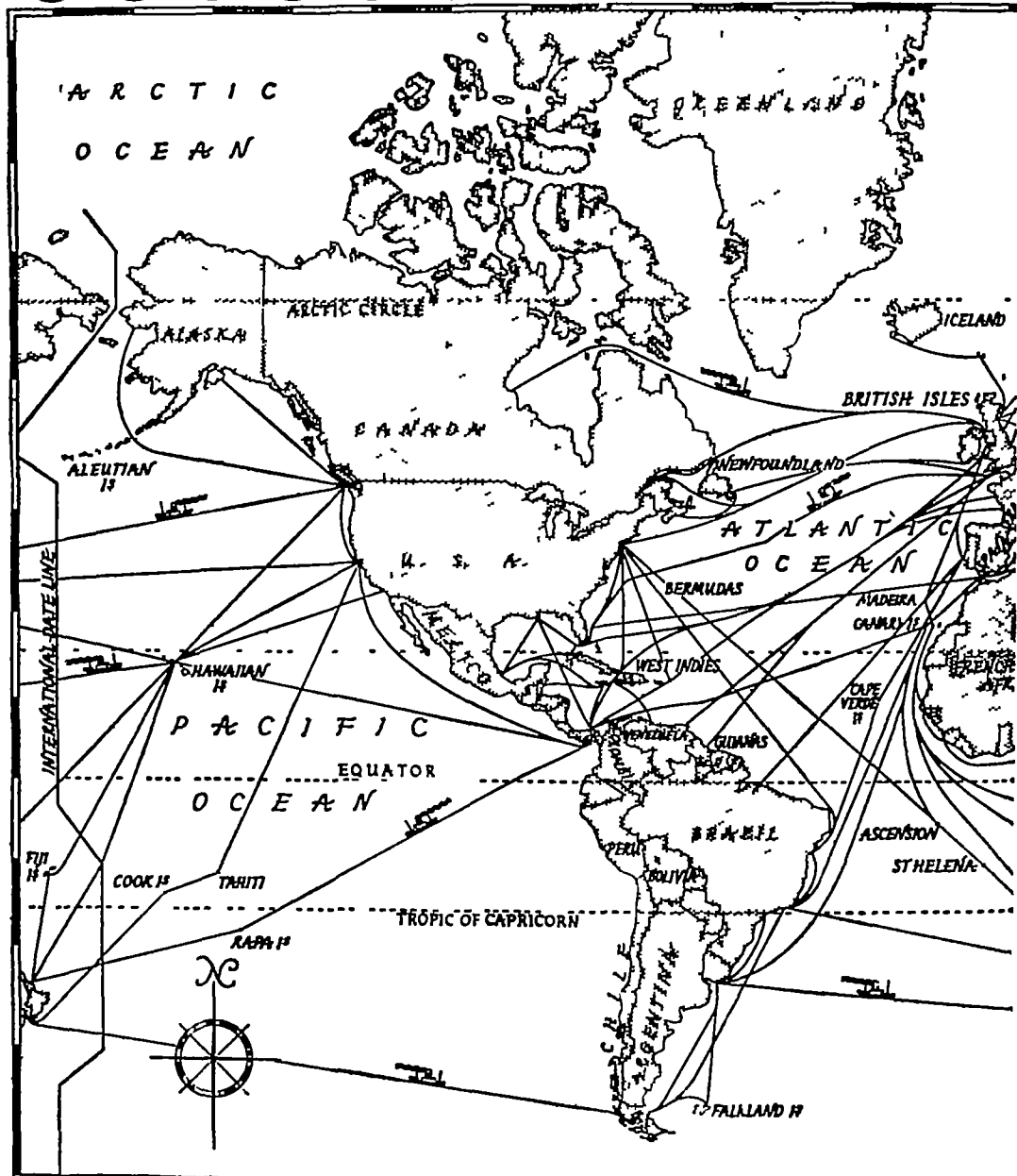
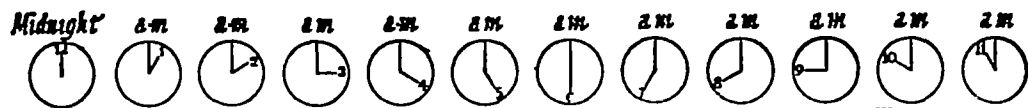
flourished the civilizations of the **ANCIENT WORLD**, including those of the cultured **GREEKS** and mighty **ROMANS**. Then followed the **DARK AGES**, the later **MIDDLE AGES**, to be succeeded by the events of more recent times, the most important of which appear in this book.

Today by reason of new inventions in **TRANSPORT** and communications, the world is getting smaller, outlying parts being less remote, and people from widely distant countries seeing and knowing much more of each other. See **TELEGRAPHY** and **WIRELESS**, and map on pages 632-633.

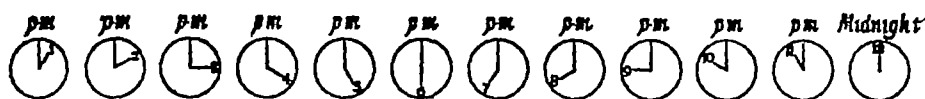
WORLD WAR, FIRST, started on 4th August, 1914, and ended with the Armistice of 11th November, 1918. The immediate cause of the war was the assassination of an Austrian Archduke and his wife at Sarajevo (Serbia). A system of alliances brought Germany to the aid of Austria, Russia to the aid of Serbia, and France to the aid of Russia. Then German troops marched through Belgium to attack France, and Britain entered the war in defence of the neutrality of Belgium. Italy in 1915 and the U.S.A. in 1917 joined the Allies against the Central Powers—Germany, Austria-Hungary, Bulgaria, and Turkey.

The chief land battles were Mons, the Marne, Loos and the Somme in the early part of the war, and the battles of Passchendaele and Cambrai in 1917. On the sea there were the naval battles of the Falkland Islands (1914) and Jutland (1916). Fierce and costly fighting took place in the Dardanelles and in Mesopotamia. British troops invaded Palestine, and Lord Allenby entered Jerusalem in December, 1917.

Lord Kitchener was the British Secretary of State for War, and did



Map of the world, showing countries, oceans, trade routes, times elsewhere when



muddy at Greenwich, with pictures of methods of travel See page 631

great work in organizing an auxiliary force known as Kitchener's Army. He was drowned in H M S *Hampshire* on his way to Russia. Admirals Jellicoe and Beatty were the heroes of the naval battle of Jutland. The French General Foch was responsible for the success of the final offensive in 1918. Lloyd George was the British Prime Minister at this time.

On 11th November, 1918, the German generals signed an Armistice, their Emperor abdicated and retired to Holland. In 1919, the Treaty of Versailles was signed, which rearranged the boundaries of Europe, and brought many new states into being. In 1920 the LEAGUE OF NATIONS was formed.

WORLD WAR, SECOND, began in September, 1939, when German troops invaded Poland. France and Britain were pledged to defend Poland, and a war began which gradually brought in most of the rest of Europe and spread to Asia, North Africa and the islands of the Pacific—a second world war.

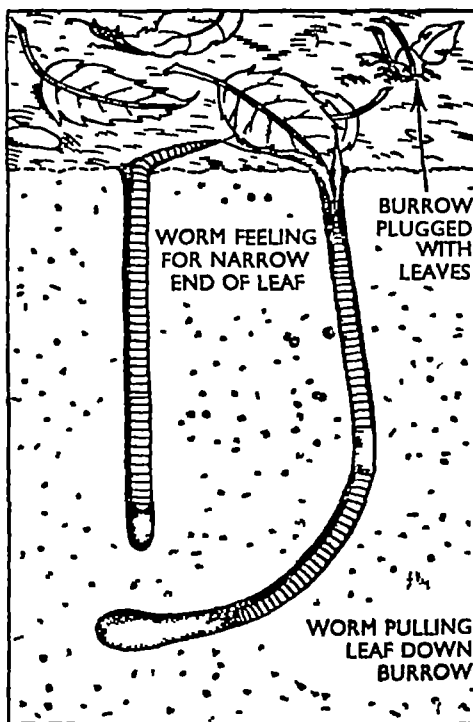
At first Russia shared with Germany in the partition of Poland, but when France, Belgium, Holland, Norway, Denmark, and Greece had been subdued by German troops, Germany invaded Russia, which joined the United Nations. Italy fought on the German side. Japan had joined the Berlin-Rome alliance in 1940, and when she suddenly attacked the American naval base at Pearl Harbour, Hawaii (December, 1941), the U S A entered the War. In Asia, China had endured invasion by Japan since 1931, and she made a brave stand. Hong Kong, Singapore and Rangoon were occupied for a time by the Japanese, and there was fierce fighting in the Dutch East Indies (Java).

The First World War on land was mainly carried on by trench-fighting, but the Second World War was a war of aeroplanes and tanks, in which the civilian population suffered as severely as the troops. The last stage of the war was marked by the use of flying bombs and rockets against Britain and atomic bombs against Japan.

In 1944 Europe was invaded, and in May, 1945, the Germans surrendered. After the atomic bomb attacks on Hiroshima and Nagasaki, following their defeat in Burma, the Japanese surrendered in September, 1945.

Field-Marshal Montgomery was the British Commander-in-Chief during the conquest of Germany under the Allied Supreme Commander, General Eisenhower (U S A).

WORM. This term can refer to earthworms, leeches, sea bristle-worms, flatworms, flukes, and tape-worms, between which is no close



Earthworm lining burrow



Sir Christopher Wren, architect of St Paul's

relationship Earthworms play an important part in agriculture by enriching soil. About 50,000 worms per acre spending their lives swallowing soil, and leaving it in fine worm casts at the surface, act as minute ploughs. Earthworms breathe through their skins and must therefore keep damp. They live in burrows which they line with leaves for warmth. Leeches cling by suckers and feed on the blood of other animals. They are a pest in tropical forests, but the medicinal leech was formerly used for blood-letting.

WREN, Christopher, Sir (1632-1723), the great architect, was born on 20th October, 1632. At first a professor of astronomy, Wren later turned his abilities to architecture, and it is in this connexion that he attained fame. In the Great Fire of London of 1666, many churches including St Paul's were among the

numerous buildings destroyed. It became necessary to have St Paul's completely rebuilt and Wren was asked to prepare the plans. In 1675 the first stone of the new St Paul's was laid, thirty-five years later he saw the last stone laid by his son.

Wren also made designs for the rebuilding of fifty other burnt churches. He also prepared plans for many other buildings, amongst which were the modern part of Hampton Court, Marlborough House, the Royal Exchange, the Custom House, the hospitals of Chelsea and Greenwich, the library of Trinity College, and the chapels of Pembroke College, Cambridge, and of Queen's

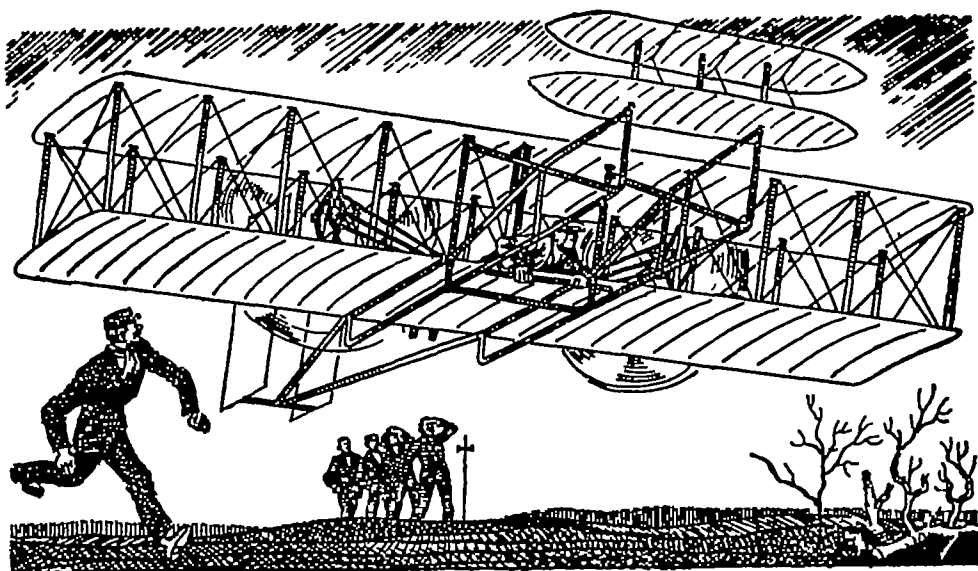
College, Oxford.

He died on 26th February, 1723, and was buried in St. Paul's Cathedral under the choir. There is a tablet to his memory over the north doorway which bears the epitaph, "Si monumentum requiris, circumspice". "If you seek his monument, look around."

WRESTLING is divided into four main styles as follows:

(1) Cumberland and Westmorland, where the two contestants clasp each other round the body with the left arm uppermost, and try to break the other's hold or put him on the ground. If any part of a wrestler's body, other than his feet, touches the ground, or he loses his grip, he loses the bout.

(2) Catch-as-catch-can, where the wrestlers are mainly on the floor, each man trying to get his opponent's two shoulders on the floor at the same time.



Original aeroplane of the Wright brothers on its first flight

(iii) Cornwall and Devon, where the contestants each wear a jacket, and the jacket or any part above the waist may be firmly gripped by the opponent. A man loses when he has two shoulders and one hip or two hips and one shoulder on the ground.

(iv) All-in wrestling, where nothing is barred, the wrestlers being free to hit and charge each other as well—a sport more in the nature of a trial of strength and endurance rather than an art calling for skill and agility.

WRIGHT, Orville and Wilbur, American brothers born in 1871 and 1867, became deeply interested in the possibility of mechanical flight. Having studied the results of German gliding experiments and devised some improvements in the equilibrium of gliders, they designed and completed a power-driven aeroplane propelled by a 12 h.p. petrol motor in which four flights were made, the longest being 59 seconds. In 1905 Wilbur Wright flew for 24 miles, remaining in the air 38 minutes, and in 1908, in a new machine, he stayed in the air for 1 hour 15 minutes. See **FLIGHT**.

WYCLIFFE, John^{*} (1320-1384), was a forerunner of the REFORMATION. He translated the Bible into English, and founded a body of "Poor Preachers" or LOLLARDS, who travelled about the country preaching the need of reforms in the teaching and practice of the Catholic Church. He wrote many tracts and was tried for heresy.



Wycliffe translated the Bible

X

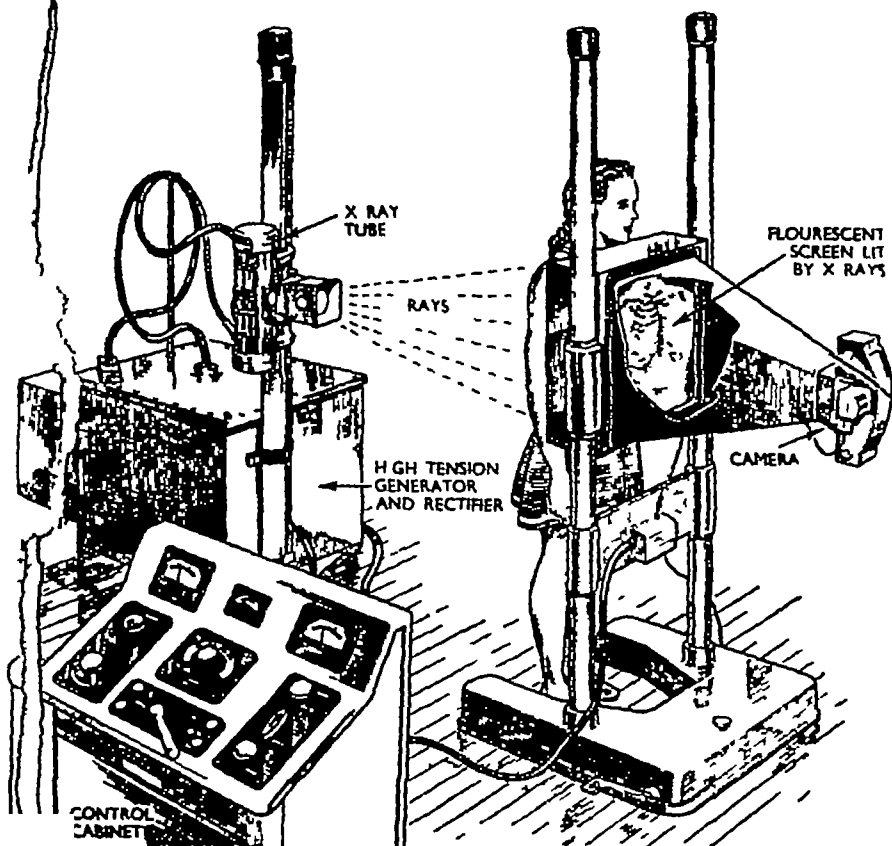
XAVIER, Francis, St (1506-1552), was a MISSIONARY and friend of St Ignatius LOYOLA, with whom he founded the Society of Jesus

XENOPHON (about 430-354 B C), was a Greek historian and military leader His military adventures are described in his *Anabasis*

X-RAYS are a form of radiation very similar to LIGHT, produced when ELECTRONS strike a solid substance at a very high speed These rays have the power of passing through many substances opaque to ordinary light, passing

more easily through some than others They affect a photographic plate on the other side, giving an image of what they have passed through, or they light up a fluorescent screen to give an image, which can be photographed So it is possible to take photographs of the structure of objects, e g the human body, to see the bones and tissues, or a metal casting, to see if there are internal flaws X-rays are also used as a curative agent for certain skin diseases See RONTGEN

XYLOPHONE See PERCUSSION



X-rays pass through the body and give a picture of what is inside

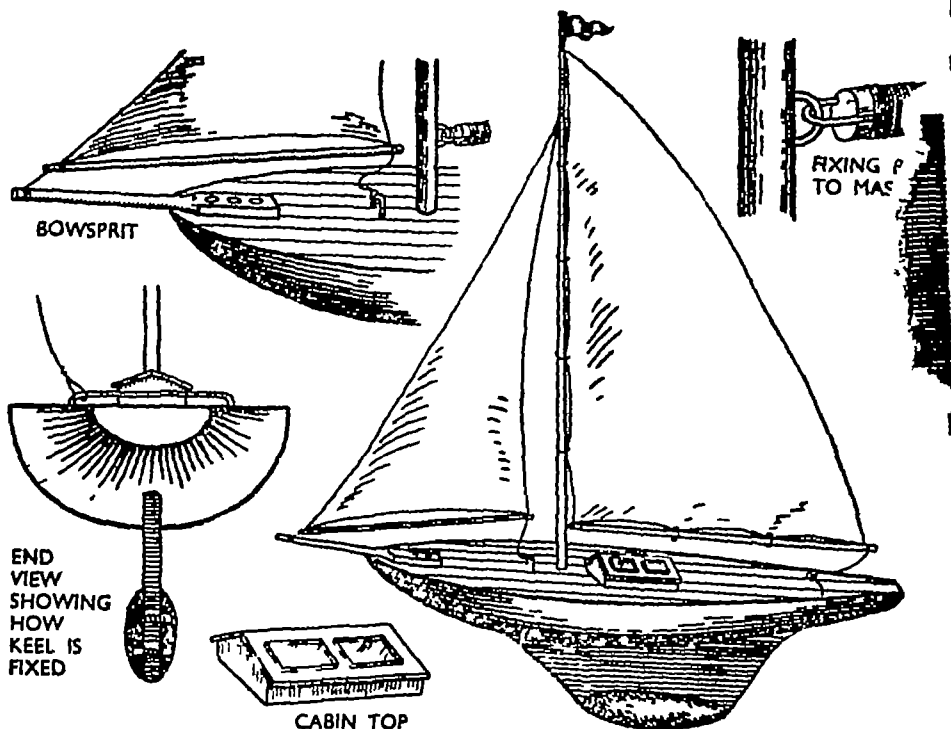


YACHTING. A yacht is a vessel with a deck, propelled by sails or motor, and used for pleasure or racing. Yachting with a big yacht needing a trained crew is very expensive, but good fun can be had cheaply with a small yacht having a cabin big enough to take two or three people. For those who cannot do this, there is always the model yacht for sailing on the local lake, and the illustration shows one which can be made quite easily. The hull is shaped from a block of well seasoned pine, spruce, or cedar. The keel is prepared from a length of beech board, tapers to a sharp edge except at the bottom where it is weighted with two strips of lead, and fits into a groove cut along the centre of the hull, in which it is fixed with strong glue.

The mast goes into a hole bored in the deck, which is scored with lines to represent boards. The bowsprit is a shaped strip of wood fastened to the deck, the boom is a thin strip of wood. The sails are made from strong cotton or linen, and fine cord is used for the rigging. Before rigging the ship it is best to give it several coats of oil paint, the whole hull is then varnished. See also BOATING.

YAK. See HOOFED MAMMALS.

YANKEE, really an inhabitant of the north-eastern states of the U.S.A. It is thought to be the word used by the Red Indians to denote the original English colonists. After the American Civil War it was used by the Southerners to denote the Northerners. Nowadays the word is used by Europeans and others to



This model yacht is easy to make and is great fun to sail

